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Design, Construction, Operation and Maintenance of all Public Works

EDITORIAL CHANGES

Beginning with this issue Municipal Engineering passes under new editorial management. Some changes in the reading matter and in the form of its presentation will be observed in this issue and other changes are planned and will speedily become effective. Service to readers is the dominant thought in editing and publishing this journal. In line with this policy the editorial matter will be classified and presented under department headings which will form a regular feature of each issue. Here are the major section headings:

Water Works Design and Construction, Water Works Maintenance and Operation, Sewer Design and Construction, Water Purification and Sewage Treatment, Refuse Collection and Disposal, Pavement Design and Construction, Pavement Cleaning and Maintenance, Plant Units and Layouts, How the Contractors Are Bidding, Digest of the Essential News, Advance Information on Big Jobs, From Workers in Field and Office, Questions and Answers, Bridges and Buildings, Sales Engineering, Lights and Shades, Fire Engineering, and Contract News.

These headings are largely self-defining, but it will be appreciated that some words used must be interpreted broadly. Thus the word pavement is used to denote all hard road and street surfaces, whether in country or city. Special attention will be given to water works operation without neglecting design and constructional features. Water purification and sewage treatment will be handled in the same department because of the similarity of the scientific principles underlying these arts. The term refuse will cover all wastes except sewage, which is separately treated. Economical plant layouts will be regularly featured and new machines, devices and materials described. Bidding prices, always much wanted by contractors, will be given in each issue. The department entitled: Digest of the Essential News is a concession to the busy man who wants to keep up to date but must do his reading on the run. The Sales Engineering department will discuss the opportunities in this line for engineering graduates and will also discuss the approved and effective methods in this field; it will also present manufacturers' salesmen to the contracting and engineering public. The Lights and Shades Department will provide easy transition from the day's work to the evening's reading.

The minor section headings are: Personal Items, Obituaries, Coming Conventions, Catalog Reviews, Book Reviews, and Trade Notes.

Each of the major editorial sections will be regarded as a separate periodical. The sectional method of presenting editorial matter has much to commend it to the reader. It facilitates the finding of matter of interest to individuals and safeguards the various interests against lack of attention on the editor's part. This scheme is wholly for the reader's benefit, and for this reason the burden it imposes on the editor is cheerfully shouldered and borne.

For twenty-seven years Municipal Engineering has taken the lead in serving those engaged in the design, construction, operation and maintenance of engineering public works. The editor requests the cooperation of the interests addressed in making this paper even more of a mutual benefit institution than before. Since its continued success depends wholly upon adequate service, constructive criticisms are solicited and will be given immediate and careful consideration.

LEGITIMATE SUBSTITUTION

Just as manufacturers in many lines have substituted one material for another to keep down costs, engineers and contractors will do well to reconsider the relative desirability of the various materials of construction in the light of war-time costs and other conditions. For example, before the war, elevated water tanks of steel and concrete were about at a stand-off so far as first cost was concerned, the steel structure having the shade. As everybody knows, all iron products have greatly advanced in price, so that now the concrete tower and tank has all the better of the cost consideration. Some engineers will continue specifying steel structures, and this is their undoubted right. These structures are tried and true. Those who in former years have considered only the steel tanks as dependable might conceivably rule against any elevated water tank in the present condition of the steel market. They should reconsider the problem now. Since their first impressions were formed great advances have been made in concrete tank work. Certainly it is better to build a concrete tank than no tank at all. And that isn't all. The modern concrete tank is durable and water-tight. Water-tight tanks have been secured in past years without using special waterproofing materials. The best practice today, however, is to make such tanks fool-proof by applying an asphalt coating to the inner surface. This costs from ten to fifteen cents per square foot for labor and material. Following this practice the concrete structure may safely be specified by those whose previous experience has been wholly with the other type of structure.

In other lines legitimate substitutions may well be considered. Formerly a situation which called for riveted steel or cast iron pipe may now call for wooden stave or machine banded wood pipe, or, in some places, reinforced concrete pipe. Under very low heads in small aqueducts even vitrified clay pipe should be more carefully considered than heretofore. Similar substitutions will suggest themselves in other fields.

These suggestions are not made to encourage change for the sake of change or to advance the interests of one group of manufacturers at the expense of another. Nothing is further from our thought. It is the patriotic duty of the engineer to keep public works construction going on in war times and if legitimate material substitutions alone make this possible the substitutions should be made.

GENERAL ARTICLES

Methods Employed in the Construction of Camp Grant Cantonment, Rockford, Ill.

At the time of writing, August 10, construction operations at Camp Grant are far advanced. The magnitude of the work may be judged from the fact that the cost is expected to reach four and a half to five million dollars. The extreme length of the camp is about two miles. The consulting engineer, who was first on the job, arrived on the 17th of June and the construction quartermaster on June 22. The work was actually begun on June 26. During the six weeks which have passed since that time, twenty million board feet of lumber have been erected and sleeping and feeding quarters put up for 6,500 men in the construction crew. During that period also eight miles of standard gage railway track have been laid in the camp, and 1,600 cars of material have been handled; 1,000 cars were handled during the first thirty days. "Speed" is the watchword on the job, and everything possible is done to expedite the construction operations.

The planning and building are proceeding simultaneously. Sketch plans are drawn up to cover the field locations, and detail plans are completed as the work progresses. This is a job on which it would have been folly to attempt innovations in construction methods, and so far as the engineering work is concerned, only well established methods have been employed. The interest in the work, aside from its national significance, lies in the fact that such an enormous body of men has been brought together from widely separated localities and has quickly become welded into a homogeneous working unit. As soon as one enters the camp, he is impressed with the spirit of optimism and of hearty co-operation everywhere prevalent.

The camp is situated at the junction of the Rock and the Kishwaukee rivers. The northern part of the camp is a mile south of the Rockford city limits. From the center of the camp to the center of Rockford is about six miles. The camp lies alongside the Chicago, Milwaukee & St. Paul railway, and ten big freight depots were speedily constructed along the railway. These were required to be completed by August 1, and before that time they were finished. They are of the familiar frame construction type commonly employed in freight depot construction, supported on concrete pillars of square cross-section. These pillars were separately cast in special forms and were erected after seasoning and curing.

Engineering work started with the making of a topographical survey of the site. The War Department at Washington furnished plans for certain units of the buildings, and these units were fitted to the topography of the site. This adjustment of the unit design to the ground was made on the ground. The camp consists of thirty-five of these units.

The design of the buildings is not gone into here, as these have been repeatedly published elsewhere. The buildings are of simple frame construction, not differing greatly from the wooden construction camp buildings with which engineers and contractors are familiar.

Water Supply and Distribution

The temporary water supply is obtained from three wells, about 130 ft. deep in the sand and gravel deposits underlying the camp. A temporary elevated tank, entirely of wood, was constructed for this temporary waterworks. These three wells are operated by gas engine driven deep well pumps of the plunger type.

The permanent water supply will be drawn from about eight wells, ranging in depth from 400 to 500 ft. These wells are at the northern end of the camp and lie on a bottom land on the east bank of the Rock river at about 10 ft. above the ordinary river stage. The wells will enter the St. Peter sandstone. Undoubtedly an adequate supply of water could have been developed from the sand and gravel deposits in the site on which the other wells are located. However, as there is an outside chance of contamination of such wells in this locality, considerations of absolute safety warranted putting the wells down to the St. Peter sandstone. A 12-in. casing was put down and sealed into the rock and a smaller bore continued into the water-bearing formation. The water in these wells rises under static head to the surface of the ground.

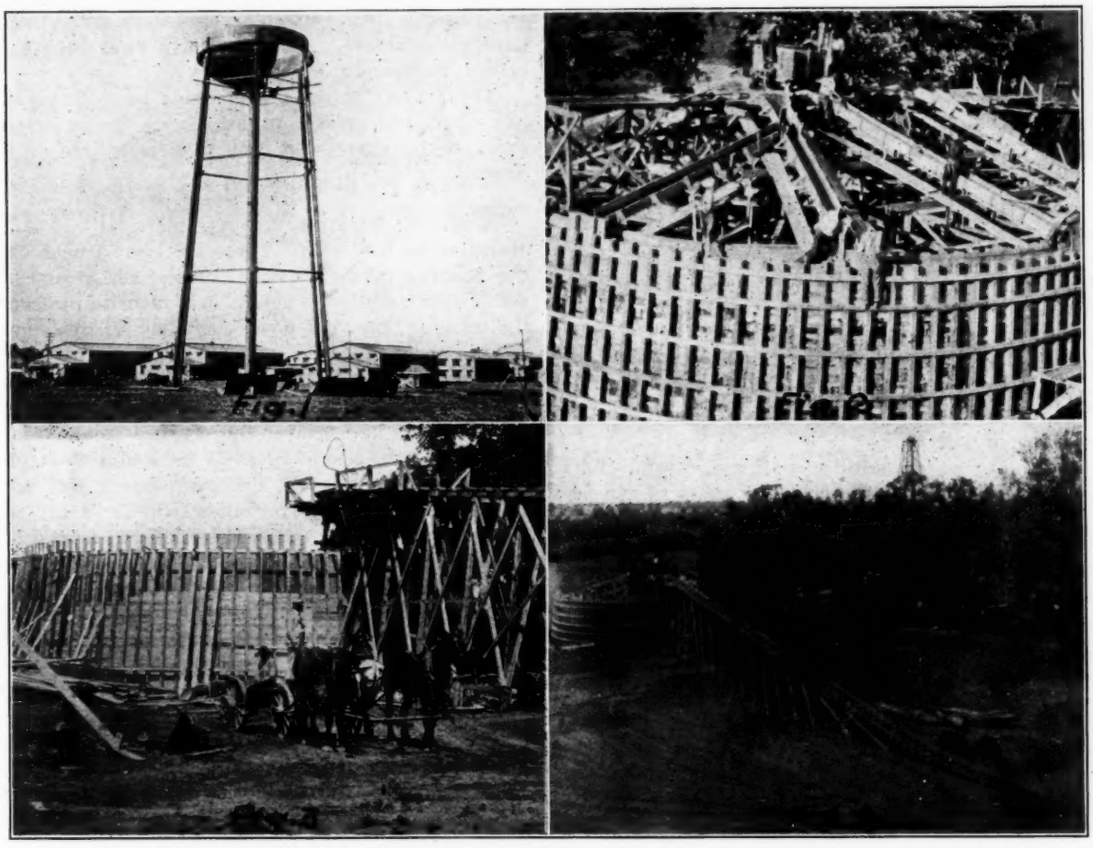
These wells will be operated on the air lift plan. Electric driven air compressors will operate the air lift. The water as pumped from the wells will discharge into a receiving reservoir 60 ft. in diameter and of 300,000 gallons capacity. The water will then be drawn from the receiving reservoir by four electric driven centrifugal pumps, discharging into a force main to the elevated steel tank of 250,000 gallons capacity on the camp site. This steel tank which was fabricated by the Chicago Bridge and Iron Co., is 140 ft. high from top of foundation to top of tank. Two of the centrifugal pumps are of American Well Works design and the other one of the Alberger design. Three of the pumps are of 1,000 gallons per minute capacity and the other one is of 750 gallons per minute capacity. The waterworks were designed for a final total population of from thirty-seven to forty thousand people. The air compressors used are of the Ingersoll-Rand design and the electric power employed is obtained from Rockford.

The construction of the circular reinforced concrete receiving reservoir mentioned is interesting with reference to the plant employed. The reservoir stands on the bottom land 10 ft. above the normal stage of the river, on one hand, and a bluff of perhaps 40 ft. in height on the other. This bluff is at the elevation of the highways, and the concrete materials required in the construction of the reservoir are hauled to a shed at the edge of the bluff, overlooking the bottom land on which the reservoir is situated. The mixer plant is part way down the side of this bluff, and the concrete materials are fed to it from troughs from the shed above. The mixer discharges into a car on an inclined industrial railway track, which extends from the mixer down to the level of the bottom land and then up again to the top of the form work on the receiving reservoir. The car is drawn back and forth by cables passing over the winding drums of a hoisting engine set on the bottom land. The concrete car used is of home construction, having ample capacity with a shear gate on either side opening by hand to discharge the contents of the car into troughs running to the forms. This is a very satisfactory layout and it works like a "charm."

The water supply pipe lines consist of 32,000 ft. of 12-in., 36,800 ft. of 10-in., 18,500 ft. of 8-in. and 14,000 ft. of 6-in. pipe. A small quantity of 4-in. pipe is used for the hydrant connections which are each 2 ft. long. Corey fire hydrants are used exclusively at this camp and all the valves used are of the Rensselaer type.

More anxiety has been experienced at the camp with the water distribution system than with any other feature of the

construction. This is due entirely to the difficulty in obtaining pipe. The first plan was to use machine-banded wood pipe, but it could not be obtained in the desired quantities within the time limits imposed by the order to have the job finished by September 1. At the time of writing, cast iron pipe was being received in large quantities, and it is thought that enough pipe will be delivered to take care of the first contingent of soldiers to arrive, at the very least. It may well be that all the pipe will be delivered in time for installation before the "dead line," September 1, is reached. Trenches are being excavated for the water mains and left open until the pipe arrives. This will make possible exceedingly rapid pipe laying after the pipe is delivered. All trenches, both for water and sewer, are being excavated by machines of Parsons & Austin manufacture. There are nine trenching machines on the job, seven engaged on sewer trenches, one on water and one on the service pipes. The service pipes range in diameter from ¾ to 2 in. Altogether there are 28 miles of water pipe, including the services, and there are 225 fire hydrants. One hundred and twenty-five carloads of plumbing supplies are on hand. There will also be twelve central heating plants. The Arnold Co., of Chicago, is in direct charge of the engineering on these heating plants.



CONSTRUCTION VIEWS ON CAMP GRANT CANTONMENT, ROCKFORD, ILL.

FIG. 1—250,000 GAL. TANK ON 6TH DAY OF ERECTION. FIG. 2—POURING LOW SERVICE RESERVOIR WALLS. FIG. 3—SERVICE RESERVOIR FORMS AND TRESTLE. FIG. 4—LOW SERVICE RESERVOIR FORMS AND TRESTLE TO MIXING PLANT.

Sewage Collection and Disposal

There are 22 miles of pipe sewers in the camp. These sewers are laid on comparatively flat grades, giving a velocity of about 20 in. a second. It is thought this will be a cleansing velocity, but if necessary, one or two flush tanks will be installed. These sewers discharge thru six outlets into the Rock river and thru one outlet into the Kishwaukee river. The latter outlet is down-stream from the camp, and thru it fully 60 per cent of the camp sewage will be discharged. Generally speaking, these sewers carry the house sewage only and surface water is admitted to them only in limited quantities. Complete surface drainage thru open ditches was not feasible, because of the peculiar lay of the land. The land has no pronounced natural slope, but is an undulating area overlying sand and gravel and containing numerous depressions and natural outlet. These depressions are in some cases being drained in a limited way into the sewer system. Submerged outlet pipe will be used at the sewer outlets to carry the sewage well out into the current of the river and give it prompt diffusion. These submerged outlets will be weighted in position with blocks of concrete. Ample dilutation for the sewage of the camp will be available, even at times of low water in the rivers. Thus it is not necessary to construct sewage treatment plants of any sort.

The handling of the engineering work on the sewer system is typical of the speed and boldness with which all moves have been made. Trenching machines were on hand before the first shipment of pipe was received, and it was thought wise to test out the sand and gravel soil underlying the camp to see how deep trenches could be dug without sheeting. When this experiment was undertaken, the sewer lines had been tentatively laid out, calling for some cuts reaching 10 and 11 ft. deep. It was early discovered that the soil would not stand without bracing at such depths, and it was, therefore, found necessary entirely to revise the layout of the sewage collection system, so as to call for shallower cuts at the expense of longer sewers. Within a half day after this decision

was reached, the entire sewage collection plan had been subjected to a root and branch revision. The new layout calls for an ordinary maximum cut of about 5 ft., and in these shallow trenches bracing is not required. There is one deep cut across a ridge reaching as high as 13 ft., and this had to be braced with great care, for the soil, while dry, has very little adhesion.

All sewer lines are laid with salt-glazed vitrified clay sanitary sewer pipe received from the Akron Sewer Pipe Co. Manholes are of two-ring brick construction with creosoted wood covers. The bottom of the manhole is made entirely of concrete.

Cost Keeping

While the quartermaster is in full charge of the work at the camp, it is necessary, of course, for Washington headquarters to have full knowledge of the conditions, so a daily telegraph report is made on each of the principal features of the work. A written weekly report gives a comprehensive view of the conditions, and weekly graphic sheets show the progress in delivering of materials and the construction of the various elements of the work. Cost data are not yet available for publication. Where speed was the governing consideration, costs have naturally taken a somewhat secondary position. This is due largely to the fact that thousands of men were employed who were total strangers to those in charge of the work, and it was inevitable that some inefficient men should be employed. As soon as the work was well under way, however, the undesirables were weeded out as fast as their shortcomings were discovered.

Under advice of the consulting engineer, careful daily studies are made to determine the field unit costs as a measure of the efficiency at which the work is progressing in different lines under the superintendents. These are taken daily to the superintendent, and any abnormal field unit cost is immediately given attention. The unit cost squad therefore became eyes for the superintendent and enabled him to watch the loose ends and lost motion of the construction in every line.

Where so much similarity of construction exists, it is only natural that a good deal of rivalry should spring up between the different construction crews, to see which can make the best record. This spirit is encouraged in the interest of speed and is supplemented by the cost and efficiency figures already mentioned. This expedient of determining field costs daily as a measure of the efficiency at which the work is progressing, introduced, as it has been, in a spirit of co-operation, has had a most salutary influence on the work from every standpoint. Mr. L. J. McHugh, C. E., is chief of the unit cost squad.

This system of checking up on output was even extended to the trenching machines. Daily records were compiled to show the output of each machine, and the best machine was rated at 100 per cent, and all others compared with this. An early result of this form of investigation was to dispose of one or two of the machines that had lost the "pep" of youth. The best record made by any trenching machine was made by the Austin "OO" which excavated 20,022 ft. of trench in 23 days, or about 872 ft. in a day. The best day's run of this machine was 1,820 ft. The average cut thruout this record-making performance was about 5 ft.

Road Construction

Within the camp there are 5½ miles of macadam road, 7 miles of gravel road and 9 miles of graded earth road. The macadam road is 18 ft. wide and has a thickness of from 5 to 6 in. at the sides and 7 to 8 in. at the center. The slope of the road section is 1 in. to the foot. Ditches along all roads are constructed with slopes of one in three on the roadside and one in one and one-half on the other side. The subgrade on the macadam roads has a crown of one-third inch to the foot. The gravel roads are 14 ft. wide and range in thickness from 6 in. at the sides to 8 in. at the center. The earth roads are 22 ft. wide and are given a slope of an inch to the foot.

Crushed stone for the macadam roads is obtained from quarries in Rockford and is shipped to the camp site in gondola cars. It is unloaded by a clamshell bucket operated by a derrick and a hoisting engine. The clamshell dumps into elevated hoppers which discharge directly into wagons and motor trucks. At the time of writing, one of these hoisting engine-derrick-hopper systems is in operation and another will soon be equipped, as it lacks only the derrick.

Water for sprinkling the macadam roads, which are laid and rolled in two courses, is hauled in sprinkling wagons of Case manufacture. There are five road rollers, of various makes, on the job.

The gravel for the gravel roads is obtained at the camp site where two gravel pits have been opened. Steam shovels excavate the gravel and drop it directly into ordinary dump wagons.

Other Plant Units

A fleet of from fifty to sixty motor trucks is in constant operation on this work. These are army trucks brought from the Mexican border. Captain Schleicher is in charge of the motor truck compnay, and it is a favorite pleasantry around the work to point out how completely he lives down the pronunciation of his name. These trucks are of Velie make and are giving splendid service. They are not of the dumping variety, but a false bottom was placed in each truck when it was being used to haul gravel and crushed stone. This false bottom had a total rise of about 14 in., and as the side boards of the box were removable, this served very well as the means of unloading. The gravel either slid down the sloping false bottom or was easily removed by a touch from a hand shovel.

Small gasoline engine driven buzz saws, made by the C. H. & E. Manufacturing Co., of Milwaukee, are employed in considerable numbers in sawing up lumber for use in building the various structures. These units are found thoroly reliable and very greatly expedite the work.

In the beginning most of the sewer trenches were backfilled with horse-drawn slip scrapers of wood. This method is being superseded at the time of writing by power-driven backfillers with the utmost satisfaction.

Gasoline for the various engines is hauled around the camp site in a tank wagon.

Purchasing Materials

In many cases the material is reserved for the contractors' use, and the maximum price for it fixed. He is notified of the arrangements made and must place the orders and see that delivery is made on time. For example, thru the lumber subcommittee of the General Munition Board, representatives of the big lumber associations of the country were assembled in Washington and agreed upon a price for lumber for these cantonments, this price not to exceed an average of $20 per thousand feet. Since many independent mills are not represented in the associations, the contractor is instructed to place at least 75 per cent of his lumber bill with the committee, and he is permitted to shop around for the remaining lumber required among the independent mills in his district. Other reservations of material were made by the government for the contractor. This included water and sewer pipe, hydrants, valves, pumps, plumbing supplies, etc. The machines used by the contractor are obtained by him as on any construction job.

Constructing Wooden Buildings

All the lumber being used at Camp Grant comes from northern Wisconsin and Michigan. It is unloaded onto the running gear of ordinary lumber wagons and hauled by horses to the points where it is required. Of course, the motor trucks also haul a great deal of this lumber.

Construction of wooden buildings was simple naturally because of the simplicity of the design. The interesting feature of the work was the routing of the various operations. The labor was subdivided in a way familiar to the those who have studied methods in the Chicago Stock Yards and in the Ford Motor factory. Thus one gang went along to stake out the site for a building; another followed and excavated for the foundations; another came along and placed the foundation timbers; another the flooring; another the studds; another the siding, and so on. Naturally these various units, going over the same kind of work every day doing again as they did the day before, became very expert and this accounted very largely for the speed in the construction of these buildings.

Special precautions are taken to safeguard the health of the men at the camp during construction and also to safeguard the buildings against fire. Captain H. C. Michie is in charge of the camp sanitation, sickness, vaccination and similar matters. Most of the wet garbage is hauled to Rockford for disposal. Army latrines are used and these are chlorinated and treated with fresh earth each day.

Special precautions are taken to swat flies and at times men have been delegated to swat flies around the cook and mess quarters. All meat consumed is stored, cooked and handled in the meat shop, which is thoroly screened in.

As a temporary safeguard against fire, fire buckets and barrels of water are kept at the corner of each finished structure. Fire extinguishers are also installed. One fire company is already on the ground and more are being installed. The camp is located on farm lands, including corn fields, oat fields and pasture lands. The oats have been cut down and stubble plowed at intervals to form a fire break.

Smoking is prohibited wherever building construction is carried on or material stored. Certain areas are designated where workmen may smoke at noon and smoking is permitted in a few buildings where constant watch is maintained. Open fires at or near building sites are prohibited. All rubbish is collected daily and removed to a place where it can be safely burned.

The kits of plumbers and steamfitters are inspected to make sure that they will not increase the fire hazard.

Personnel

Maj. D. H. Sawyer is Construction Quartermaster in full charge of all work at the camp. Lieut. D. A. Tomlinson is Adjutant. Alvord & Burdick, of Chicago, are the Consulting Engineers, and E. H. Bennett, of Chicago, is the Consulting Architect. Much of the admirable layout of the camp is due to his care and preliminary study of the necessary working conditions. Joseph Morrow, Asst. Chief Engineer of the Chicago & Western Indiana Railway, was "loaned" to the camp by E. H. Lee, Chief Engineer of that road. Mr. Morrow has had charge of the construction of all switch tracks and subways. Mr. P. Maloney, as Supervising Engineer, has charge of building construction, lighting and plumbing.

The Bates & Rogers Construction Company, of Chicago, are the contractors. There is not a sub-contractor on the job. The Bates & Rogers Construction Company are handling this work with their executive officers in direct charge and the work is occupying a considerable part of the attention of their organization.

Both Mr. Alvord and Mr. Burdick are spending all their time at Rockford and the water, sewer and road construction is going forward daily under their personal supervision.

Altogether there are about 100 experts at Camp Grant, each responsible for a part of the work. These men have cooperated in a manner that is an inspiration to an outsider. A strong patriotic feeling is everywhere in evidence and this includes the majority of the common laborers.

Influence of War on City Planning

In Europe, aviation has raised a whole series of new problems, in the planning of cities, many of which demand immediate solution. When in France last fall, the writer was taken out to one of the great aeroplane camps used in the defense of Paris and that was only one of a large number of aeroplane or balloon fields thruout France. These fields for training, maneuvres and storage require acres of continuous open space almost level in character and well drained. Around most cities such space is difficult to find and it is only by planning well ahead that adequate reservations can be made.

Landing Place for Aeroplanes.

The remarkable increase in the common use of aeroplane and dirigible balloons in Europe today makes it obvious that their use for commercial and pleasure purposes after the war is going to be perhaps as rapid in its growth as was that of the automobile. This presents the problem of providing convenient landing places for aeroplanes. In New York City, about the only place that has been considered desirable for landing is Governors' Island. With the thousands of aeroplanes that will be flying in this country within a few years, whether the war lasts or not, the problem of finding landing spaces, will become rapidly more urgent. In fact, the Post Office Department is now, in conjunction with the Aero Club of America, planning to select appropriate fields for landing in or near every important center. In France, most of the aeroplanes, from a standing start, go only some 100 or 150 yards before leaving the ground and then shoot up into the air at surprisingly sharp angle. They land easily in a 30-acre field. There are any number of places in New York, and in most of our other cities and towns, which would make ideal landing places if they were leveled off, and trees, bushes, wires and other obstructions removed. The problem of landing at night is perhaps the most difficult, and dangerous of all. In France, we found the landing places specially lighted by searchlights or by a peculiar formation of the surrounding lamps, so that seen from above, they are readily recognized. Then too, by day all sorts of special indications were used—whitewash or colored diagrams drawn on the ground, so that an aeroplane from a mile or two in the air could recognize the significance of the marks.

Advantage of Military Highways.

One of the most important problems for the city in time of peace, is the moving of crowds of people quickly from one place to another. Its importance is increased ten-fold in time of war. In France we saw everywhere parts of a great network of national military roads. They often go straight up and down over hills and valleys as did our old turnpikes, but always with the grades cut down to the minimum and with ample width and excellent surface. The roadways are never too narrow for two great motor trucks to pass each other at high speed; far different from our niggardly custom. Tho these national roads go thru the towns and cities, even in the larger cities they continue to belong to the national government and are paid for and maintained by it. They are the backbone of efficiency in the handling of people and goods about the country. Without them, France would have had the greatest difficulty in meeting the situation with which she has been confronted.

As for the railroads in France, here again we found men could be mobilized or handled in masses from one town to another with the greatest ease and speed. The special characteristics were ample approaches to the railway stations and extensive yards.

Increased Transportation Facilities.

In the transportation and handling of supplies, we found that great changes have been made in France since the be-

ginning of the war. In almost all of the freight yards that we saw, extensions were being made, new terminal tracks being put in, huge new warehouses being built, all with a view to handling war supplies quickly and without waste. At Marseilles we saw a great new classification yard along the new docks that the city is now building, rendered necessary by the trade that has come to the port on account of the war.

We went over the ports of Marseilles, Bordeaux, Rouen and to some extent Havre, but we hardly recognized them, so much had they been changed; the ports being doubled, trebled, and even quadrupled in size and even at that, ships waiting at anchor for days and weeks outside the port for a chance to unload. It was a condition of things that troubled us a great deal, for we realized that hardly a city in America was prepared to meet emergency conditions in like fashion.

Handling of Materials.

The thing that probably impressed us most in the handling of goods both along the waterfront and in the local terminals, was the extensive use of handling machinery. Even in the small villages, the freight yards were equipped with cranes and other handling devices, while in the larger yards and along the docks almost nothing was done by hand. Any mechanical device that would save labor was more than paying in its way, as it released men for services at the front.

The handling of foodstuffs for the civilian population is a problem to which France has given careful thought for a good many years. Every city, town and village has its municipal retail markets in big halls open at the sides, where stalls are rented to the little dealers at the minimum economic rental. This gives the city a chance to control not only the healthfulness and quality of foodstuffs, but also the maximum prices, all of which has proven a most effective means of keeping down the high cost of living during the war. More than that, however, there has been a very strong tendency of late years in France, as well as in other European countries, to develop public wholesale auction markets and a number of big retail markets have recently been changed for the most part from retail to wholesale use, all of which tends to keep down costs.

Many Housing Improvements.

In housing, we were astonished at the striking development which has taken place since the war began. We found in Limoges for example, that some six acres of four and five-story tenements in the heart of the city had been razed to the ground. At a cost of a great many millions, the city was going ahead in the midst of war times to lay out new and broader streets and rebuild the district along modern city planning lines. In Marseilles, we found fourteen and a half acres of old six and seven story tenements in the center of the city already torn down. At a cost of something like forty million francs, the city was laying out new broad streets and open spaces, erecting new buildings of a modern character all as a matter of "preparedness for peace." It has been borne in on them very strongly that with the loss of a million or more of their best men, they are bound to do everything they can to preserve and build up the next generation; that they cannot afford to let it grow up in unsanitary and disagreeable surroundings.

We found in Paris that the city government had since the beginning of the war organized a city planning bureau with broad powers which is planning comprehensively the whole metropolitan area, not only within the city but thru all the surrounding district. In Lyons, we found similar plans being worked out. In London, the architects, engineers and city officials have come together and are working out most extraordinarily comprehensive plans specially for traffic routes for an area of nearly 2,000 square miles around London.

The Planning Commission.

But more striking still, were the plans which they showed us for the replanning of Rheims and some of the other destroyed towns. In France, they have come to realize that they must make a virtue of their necessity and rebuild the destroyed cities along modern, scientific lines, always preserving as far as possible the charm of the past. They have gone further still, and now appreciate the vital need of general scientific planning. They have actually framed a law which has already passed the Senate—the Loi Cornudet—according to which every city, town or village in France, regardless of whether it is in the destroyed area or not, will be forced to lay out all its future developments according to modern city planning principles. Every community will have to have its city planning commission, over which there will be a general commission in each of the 86 departments, and over these in turn, there will be a federal commission, so that all may work along similar lines and so that the whole area of France will be laid out according to one great comprehensive plan.

They are doing these things because they find that they have got to do them to meet the economic competition with other countries which is coming after the war. There must be no waste, and they are providing to eliminate every possibility of it. France is doing all these things at enormous cost, despite the superhuman work of carrying on the war. She is doing it because she finds it necessary to make up for the mistakes of unpreparedness. We in America are remarkably fortunate in having the example of their experience before us. It is comparatively easy for us to plan for these emergencies; be they in aviation, in the transportation of men or supplies, in housing or recreation, or in the working out of general all including plans. In peace times, it is sheer common sense to give our best thought to the planning of our cities. It is imperative to do so now to meet the demands of war.

Keep Up With the Truck

By C. P. Cary.

The reality of war brings home to us the seriousness of our transportation. We have been accustomed in peace times to pay as high as 7 per cent. as a charge for delivering to our homes the food we eat. We did not feel it, this charge being nominal and included in the cost of the purchases. We traveled from our homes in the country to our business in the city on the steam trains, in many instances for less than two cents per passenger mile. This afforded the man of small salary and large family a healthful home for his children in the country.

Recently the Interstate Commerce Commission listened to officials of railways concerning the 15 per cent. increase in freight rates. This was claimed as necessary in order to assure the roads a safe marginal profit which would justify the needed requirements. This advance in rates will not compensate for expenditures necessary to provide new rolling stock and equipment imperative for intensified service necessary now.

Two Hundred Per Cent. Increase in Freight Traffic.

The advance in labor and rolling stock during the past three years exceeds in some cases 100 per cent., and the demands so far exceed production that no one knows to what height this increase will go. Intensified railroad development already has reached the maximum, and increased capital with extension of lines is now necessary. There has been an increase during the past ten years in locomotive tractive power of over 40 per cent., with an equal increase in freight car capacity. During that period trains have increased their tonnage over 70 per cent. Freight traffic has increased in the eastern cities 200 per cent. faster than the population. Still cities everywhere are rapidly spreading, and demands for spur tracks with locomotives and cars are in urgent demand. This

kind of work handicaps the transfer of freight, for the equipment is greatly needed elsewhere.

Transportation is one of the most vital problems confronting the entire world at present. It is demanding the concerted efforts of the best brains to prevent an immediate breaking down of both land and water systems. It requires a stupendous amount of money, materials and skilled labor immediately.

Motor Buses in the West.

In California motor buses have successfully operated at two-cents per passenger mile. During the summer of 1916 in Yuma, Ariz., 6-ton motor trucks hauling 6-ton trailers, delivering road material over the desert roads a distance of 13 miles, operated consistently 24 hours out of the 24 hours in the day at a ton-mile cost of $0.051. The writer examined these trucks after 15,000 miles of this kind of service and found them in excellent condition.

California, Arizona and Nevada have of necessity developed the motor truck and motor bus to a point where they successfully bridge the gap left open by inadequate steam and electric railways. Last summer one could ride from Stockton to Sacramento, 53 miles distant, in a comfortable bus, at an average speed of 25 miles an hour for $1.00. A ton of goods could be delivered in San Jose from San Francisco, 50 miles distant, by motor truck, at a less charge than by any other common carrier. Motor stages operate between San Francisco and Los Angeles at the present time, covering nearly 400 miles in the trip, at a charge equaling steam train fare. From San Pedro Harbor to Los Angeles, motor trucks, hauling several trailers, delivered 25 to 75 tons per trip at an operating charge of less than 50 per cent. of the costs of any other transport.

London, Liverpool and Manchester have for years operated lorry trains, consisting of two or more trailers attached to a steam or gasoline tractor.

Highways Should "Stand the Gaff."

We have not as yet discovered the true application of motor vehicles. There is no instrument of transportation available today capable of such immediate and immense possibilities. Yet this great asset to the country is in its swaddling clothes thru lack of intelligent and systematic application. It is not only a lamentable but serious fact that less than one per cent. of business houses using motor delivery are familiar with its value of operation, and this important system is left to the discretion of men incapable of improving or perfecting this branch of the business. In fact, the cheapest grade of labor is used, not only in the operation, but in the disposition of these units.

The government will do much to improve motor truck application for its specific requirements, particularly within the provinces of the military branch. It will not develop the truck as a public utility. This cannot be done until a systematic co-operation has been promoted by the government and a commission appointed of transportation men from the railroads, motor truck interests and men selected from the state highway commissions.

We cannot afford to delay longer such an action. Our highways are our public arteries, which should be used for intercity, passenger and freight traffic. We should be using now motor truck trains as freight carriers and our freight depots should be open 24 hours daily. Our big business houses should inaugurate a 24-hour-of-the-day service in their freight departments. Intelligent improvement should be made in our highways, bridges and culverts, as well as in the laws governing the use of motor trucks and motor buses as common carriers. Until the government takes such action, the few of us who are striving to bring highway transportation into its own will be only continuing to drive a square peg in a round hole.

WATER WORKS MAINTENANCE AND OPERATION

Installing and Maintaining Water Service Connections in St. Paul

By Garrett O. House, General Superintendent, Bureau of Water, St. Paul, Minn.

On December 31, 1916, the records of the St. Paul water department indicated that 40,072 service connections were in use. Of this number, 34,879 were metered, 4,983 were on flat rates and services laid in advance of paving, and 210 were fire supplies. Of this entire number, 35,000 are ⅝ inch in diameter.

The size of service connections can be controlled by the proper selection of a method for charging for service connections. Four methods are in common practice in the United States:

1. The water works installs the service connection complete from main to building, and considers the expense thereof a part of the distribution system investment.

2. The water department makes the tap in the main, charging the owner of the premises supplied the cost thereof, and authorizing a licensed plumber to install the balance of the service connection under the supervision of the water works at the expense of the owner of the property.

3. The water department installs the service from the main to the property line at the expense of the owner, and authorizes a licensed plumber to complete the service into the building under prescribed rules and regulations relating thereto.

4. The water department makes the entire installation, charging the cost thereof to the property owner.

Methods two and three are the most common, the first and last being used in only a few cities.

How Services Are Paid For

The rules of the St. Paul Bureau of Water provide that the bureau will furnish all of the materials and do all of the work incidental to the installation of the service pipe from the water main to the property line. Method three referred to. While this procedure requires a considerable organization and involves considerable labor and supervision, I believe it is the proper way to install connections, because experience has shown that men engaged in this line of work become, after a reasonable amount of experience, expert, and that the work done by them is better than by the ordinary plumber who has very little experience, and also because the city purchases better materials, and they are more carefully inspected, and also performs the labor for a lower price, all of which results in a benefit to the owner of the premises served, who

is, by virtue of being a citizen, a stockholder in the water works.

In St. Paul, the cost of all labor and materials for service connections from the street main to the property line is paid by the property owner. This procedure is, in my judgment, better than for the water department to make at its own cost the service installation, considering it as a portion of the investment in the water works plant.

The material entering into a service connection less than 3 inches in diameter is of materially shorter life than the underground street mains and is, therefore, less permanent.

It is also a fact that demands for larger service connections than necessarily would be made unless rules and regulations were laid down limiting the size of service connections with reference to the size of building or use which was to be made of the water. When the consumer pays for the service connection, he does not care to make a larger investment than is necessary, and the size of service connection is kept as small as necessary.

The question of maintenance and repairs for this service connection during its reasonable life is also a debatable one.

All Repairs Paid by Owner

At present, in St. Paul, the water department makes all repairs to water service connections at the expense of the owner, the actual cost being charged therefor. In my judgment and in the light of experience in St. Paul, this rule should be changed so as to provide for the maintenance and repairs by the Bureau of Water and at the expense of the Bureau of Water for a period of time representing the reasonable life of the service pipe.

The regulations of the department of public works in St. Paul, who have exclusive jurisdiction over all public streets, provide that no unlicensed person shall make any excavation in the street. If the owner of premises is not permitted by the department of public works to make any excavation in the street and is not permitted by the Bureau of Water to make any repairs to the water service connection, and further, if the Bureau of Water installs the water service connection, the owner has very little to say about it, and, in my judgment, cannot be held responsible for other than natural deterioration of the service pipe, which should be guaranteed to him for a reasonable life.

The repairs which are usually necessary to be made to water service connections of the smaller sizes when installed, either of lead or galvanized iron pipe, are due to imperfect workmanship or materials, or to settlements near the pipe on account of other excavations, or to freezing or electrolysis, to none of which can the owner be held responsible.

Mitigation of Electrolysis

One of the principal causes of deterioration in many cities, with both water mains and service pipes, is that due to electrolytic action caused by stray electric currents passing from the service pipe into the surrounding soil.

The source of these stray electric currents is usually from the rails of an electric railway system.

Electric current used for propelling street cars is usually direct current generated at about 500 volts. It is conducted along the trolley wires, down the trolley pole, into the motor, and from thence is conducted to the rails, and from thence back to the generator in the generating station.

On account of the numerous joints in the street railway rails, and imperfect bonding around them, the return current often finds a path of less resistance through the earth and jumps from the rails into the earth and on to the pipes of a water works which are laid in the ground; and as they offer a path of still less resistance than the earth, the return current follows along them to the generating station, instead of over the rails or the earth. If the water pipes should offer no resistance, the return current flowing on them would do no damage, but at various points considerable resistance is offered and the current jumps from the water pipe into the ground again. At these points electrolytic action is set up, causing deterioration of either lead or iron pipe, the rapidity depending upon the amount of current flowing.

The most successful means now employed to eliminate electrolysis is by the installation of insulated copper cables, connected at frequent intervals with the rails and finally terminating at the generator in the generating station.

This means is effective because a path of less resistance than over the rails, the ground, or the underground water piping system is made, so that the return current has no desire to leave.

The worst feature of electrolytic action to a water works company is that it is progressive and cannot be detected until deterioration has progressed so far as to cause the pipe to leak, and it is not at all certain that because no leaks are discovered that damage from this source is not being caused.

Another cause of trouble which we all experience in this northwest country is that of freezing service connections. Our experience in St. Paul in this respect is particularly interesting.

Thawing Out Frozen Services

Previous to last winter, frozen water service connections were a source of anxiety to the department. When complaint was made that a service connection was frozen, no one could, with certainty, in most cases, determine where in its length the frozen portion could be found. It was first necessary to excavate to expose the corporation cock and gooseneck as the most likely point of trouble, disconnect the union and observe. If no water came, or ice was seen, it was evidence we had made a poor guess, and that another excavation was necessary. When the trouble was located it was removed by the application of heat. This procedure would occupy from two days' to two weeks' time, during which the consumer was deprived of a water supply and was usually bitter in his denunciation of the water department.

After a very careful investigation, the writer prepared specifications for a gas engine electric generator set to be mounted on a motor truck trailer. The engine is a 4-cycle gas engine designed to run at 1,000 revolutions per minute at full load. It is direct connected by a leather link, flexible coupling to a generator.

The generator is of the direct current type, having a rating of 20 kilowatts, producing 500 amperes at 40 volts. For the control of the generator a switchboard is installed, upon which are mounted indicating electrical instruments together with a regulating rheostat, designed to regulate the voltage generated by the generator between zero and 40 volts. In addition to the engine, generator and switchboard, there is also a reel installed on the truck, mounted on a steel frame. This reel carries 500 linear feet of 300,000 C. M. extra flexible insulated copper cable, in 100-foot lengths.

The trailer is a Troy trailer of the reversible motor truck type, having a capacity of 1½ tons. The generating equipment and reel are secured to a steel frame, so that the entire equipment as a unit can be removed from the trailer in the spring and permit the trailer to be used during the summer season for any other purpose.

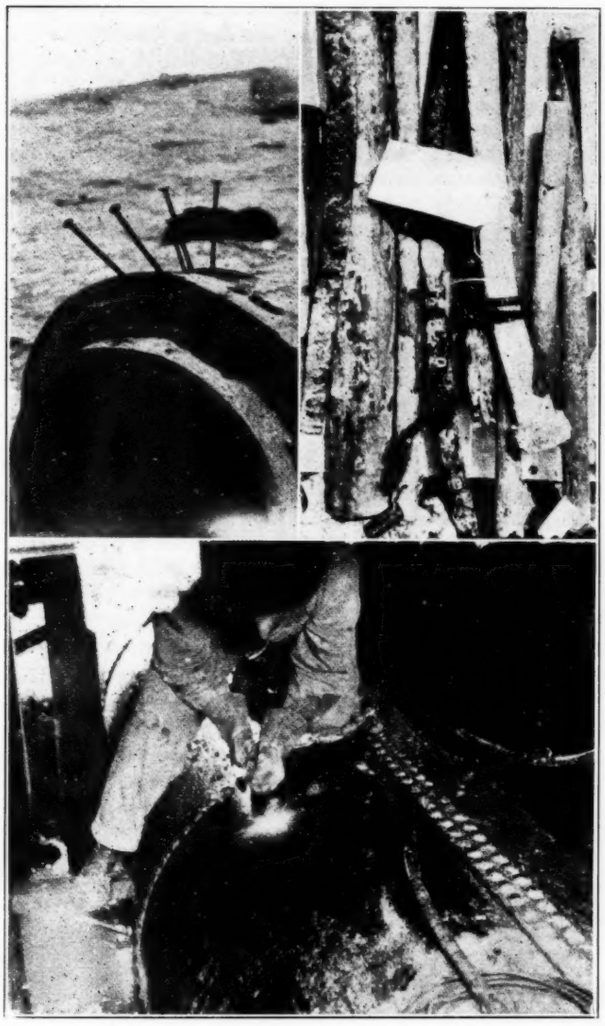
Special Plant Thaws Pipe in Few Minutes

The procedure in thawing out a frozen service pipe is about as follows:

The trailer is attached to a motor truck and hauled to the location of the frozen service pipe, a sufficient amount of cable is unreeled to reach from the generating apparatus to the basement of the house, and also another line to reach from the generator to the nearest fire hydrant. One end of the first cable is attached to the positive terminal of the main switch, and the other end attached to the service pipe on the

street side of the meter in the meter box. The second cable is attached to the negative terminal of the main switch and to the revolving nut on the top of the nearest fire hydrant. The gas engine is then started and brought up to speed with the main switch open. The main switch is then thrown in, and, by means of the rheostat, the generator is regulated to give about 400 amperes at zero to 5 volts. After running at this point of regulation for about a minute, the voltage is raised to about 75 per cent. of the capacity of the machine, and at this rate it is seldom necessary to continue furnishing current for more than three minutes. Most service connections are relieved of the ice obstruction in two minutes. In a few instances with large pipe and serious freezing, it has taken fifteen minutes to remove the obstruction.

During the winter of 1916, sixty-one connections were thawed out, and thus far in 1917 we have used the machine in seventy cases. It has operated with perfect satisfaction, and we have never yet found a case where relief could not be given.



EFFECTS OF ELECTROLYTIC ACTION ON SEATTLE WATER PIPES. LOWER VIEW SHOWS MAIN BEING CUT FOR REPAIR.

In the winter of 1916, which was the first season service was given by the machine, we attempted to charge for the actual cost of the use of the machine, including labor, supplies, interest and depreciation. It became evident that this method was not fair, because the owner of property a long distance from the storeyard of the water department was compelled to pay considerably more for the service than one who lived within a few blocks, so that this year we are charging a flat rate of $5 per service, which is payable in advance.

With this machine in successful operation, we can now assure a consumer of water, who is so unfortunate as to have a frozen service connection, that relief can be given in a few hours, which is real service and carries with it much more than its intrinsic value.

Seattle Electrolysis Problem

By L. B. Youngs, Superintendent Water Department, City of Seattle

Grounded current from the power system of the Puget Sound Traction, Light and Power Company, which operates the street car lines in Seattle, is responsible for an incalculable loss in ruined water pipes, the destructive effects having extended over a considerable period of years. This has for a long time been a perpetual source of expense to the department. Bills have been presented to the company regularly for the cost of these repairs, but thus far the company has refused to acknowledge any liability.

Investigation Shows Damage

A thoro investigation into the cause of this destruction of pipes and services was made during the years 1911 and 1912, and the evidence placed in the hands of the corporation counsel. As an example of this destructive action of the electric current on the pipes, I incorporate in this article a few pictures taken at points where the pipes had to be renewed.

Few people realize how rapidly an electric current will eat out a pipe. On Melrose avenue the banding on 4,000 ft. of 18-in. wood stave pipe was eaten out in seven years. The 42-in. steel pipe on Twelfth avenue, south of Jefferson street, was badly pitted and in some cases eaten entirely thru. Along one seam lengthwise of the pipe for a distance of 6 ft. the metal was three-fourths gone. The pipe had been in the ground only ten years. The holes in this pipe had to be plugged with rivets and some of it replaced with new pipe. The destruction is most rapid, however, in the case of small service pipes. Some of these have been eaten out in three months. At 1221 East Jefferson street a service pipe was replaced on August 7, 1909, again on March 30, 1910, July 3, 1910, and October 17, 1911.

More than Ten Thousand Dollars Damage

Up to the date of the last water department report the repairs on mains and services that have been made necessary on account of destruction by electrolysis amount to nearly $10,000. Of course, this does not take into account the constant disintegration of the pipe which is going on and which reveals itself only when the pipe fails to convey water and breaks into leaks.

Kansas Law Requires Oil-Free Water

As the result of considerable trouble with drinking water caused by discharges from oil and gas wells, the Kansas Legislature has passed a bill making it an offense to permit any discharge that will render city water supply "deleterious for use for domestic purposes." The fine for violation of this statute has been fixed at from $25 to $100 per day for each day the oil causes damage. Prosecution must begin not more than ninety days from date of the offense. That such legislation was a necessity may be seen from an analysis recently made of water from the Walnut river, near Douglas, Kans. This showed a solid content of 2,736 parts per million, the principal parts of which were sulphates and chlorides.

ADVANCE INFORMATION ON BIG JOBS

Information for Bidders on the Shandaken Tunnel Contract

Bids will be received by the Board of Water Supply of the city of New York, at its offices, twenty-second floor, Municipal building, Park Row, Centre and Chambers streets, New York City, until 11 a. m., on Tuesday, September 11, 1917, for a contract for the construction of the Shandaken tunnel. The tunnel is part of the Schoharie watershed development for the New York City water supply, is 18 miles long, and will carry water from the Schoharie reservoir to Esopus creek. The finished tunnel will be 11 ft. 6 in. high by 10 ft. 3 in. wide, lined with concrete masonry, and will have 8 shafts.

The tunnel has been divided into two portions, to be known as the north and south portions, so that bids may be submitted for either portion or for the entire tunnel.

At the above place and time the bids will be publicly opened and read. Pamphlets containing information for bidders and contract drawings can be obtained at the above address, at the office of the secretary, by depositing the sum of $20 in cash or its equivalent for each set. For further particulars apply to the office of the principal assistant engineer at the above address.

General Features of the Shandaken Tunnel

Four general lines for the tunnel were considered during the engineering studies preliminary to final location and design: Two lines beginning east of and two lines west of the Schoharie creek, the difference in the two of each set being in their relative shaft locations. The four lines joined on the west side of the Schoharie creek at a point west of Lexington, from which point they were common, entering the Esopus valley near Shandaken. The two easterly lines were abandoned, as they were more costly.

The location finally adopted has the headworks on the westerly bank of the Schoharie creek, on the Delaware-Schoharie county line, and enters the Esopus valley near Allaben.

The general features of the Shandaken tunnel are as follows:

Length, miles	18
Capacity, gallons daily	600,000,000
Elevation of intake	1,050
Elevation of outlet	970
Slope between shafts 1 and 7	0.000834
(equals 4.4 ft. per mile, or 1 in. per 100 ft.)	
Height	11 ft. 6 in.
Width	10 ft. 3 in.
Number of shafts	Intake shaft and 7 others

Between intake shaft and shaft 1 is a pressure tunnel.

Maximum depth of shaft, 629 ft. at shaft 5.

Minimum depth of shaft, 319 ft. at shaft 2 (not including intake shaft, which is 260 ft.)

Total depth of shafts, 3,315 ft.

Greatest depth of tunnel below surface, 2,215 ft. under top of mountain just east of Deep Notch.

Specific and General Information to Bidders

The work contemplated in the contract is the construction of the Shandaken tunnel in the towns of Gilboa, Schoharie county; Roxbury, Delaware county; Prattsville and Lexington, Greene county, and Shandaken, Ulster county, New York. The tunnel is approximately 18 miles in length and is a part of the Schoharie watershed development for the New York City water supply. It will carry water from the Schoharie reservoir, which will be formed by constructing a dam across the Schoharie creek valley at Gilboa to the Esopus creek, at a point near Allaben. From this outlet the water will follow in the natural bed of Esopus creek to the Ashokan reservoir.

The main tunnel will be substantially of a horseshoe shape, 11 ft. 6 in. high by 10 ft. 3 in. wide, lined with concrete masonry, and in residual spaces above the masonry lining filled with grout. The tunnel will have eight shafts; the most northerly one will have at its head the intake chamber and the others will be decked over and covered by small superstructures. At the southerly end there will be a short stretch of aqueduct constructed in open cut and a short walled and paved outlet channel connecting the tunnel with Esopus creek.

Access to the Work

Grand Gorge station, on the Ulster & Delaware Railroad, is about 5 miles distant from the two northerly shafts, and Shandaken station, on the same railroad, is about a half mile from the southerly end of the tunnel. The shafts are, in general, located near a main highway going over the mountain from Shandaken to Prattsville. In order to afford better and more ready access to the most northerly or intake shaft, the grading of a portion of a new highway, which will be made necessary by the Schoharie reservoir, is included in the contract with a view to its use in constructing the tunnel. Permanent access roads are also to be provided to each shaft from adjacent highways, and these may be built early and used for construction purposes.

Power for Construction Purposes

Under suitable conditions use will be given of Catskill aqueduct and reservoir lands, as well as lands of the Shandaken tunnel, for a temporary power transmission line from the lines or plant of an existing power company or from a power plant to be established by the contractor. A study of methods of securing power for constructing the tunnel has been made, and this information is open to examination by bidders at the office of the engineer.

Geographic and Topographic Features

The principal geographic features near the site of the work are shown on the locality map of the contract drawings and complete topography of the region may be found on the Gilboa, Hobart, Margaretville and Phoenicia quadrangles of the United States Geological Survey.

For the convenience of intending bidders, the line of the proposed tunnel has been marked upon the ground with sufficient clearness to enable a person to find it readily. Conspicuous signs have been placed at the shaft sites.

Blasting a Canal

The canal of the Miles City, Mont., Canal and Irrigating Co. was washed out by a flood on the Tongue river and the face of the bluff had to be removed to give place for the new location of the canal. H. E. Fearnall, engineer for the company, did the job with DuPont blasting powder and red cross dynamite. He bored a series of holes horizontally 8 feet into the bluff, large enough to slip in a 25-lb. can of powder with three sticks of dynamite in it. Holes 3½ feet apart for about 100 feet in length are used in one blast. The blasts were used down to the bottom of the canal.

HOW THE CONTRACTORS ARE BIDDING

Recent Bids on Pipe Sewers and Sewage Treatment Plant in Illinois Towns

Engineers are requested to send the editor tabulations of contractors' bids received on all sorts of public works construction jobs. The data given should not be fragmentary, but should approach completeness as the desirable limit.

While the title of this section is considered self-defining, let it be said by way of amplification that enough explanatory matter should accompany the tabulations of bids so that the reader can interpret the prices given and form a clear idea of what the figures signify. The ideal form of presentation is a short story giving a digest of the specifications under which the bids were received and describing local conditions which influenced the making up of the bidding prices. With all the information at his finger tips, these data can be compiled by the engineer in surprisingly short time.

It is desired that all parts of the country be represented in this department and all branches of public works construction covered. The contractor is a migratory bird and is attracted to localities where high bidding prices prevail. Thru this department engineers can check up on the bids they are receiving in comparison with those offered in other places.

TABLE I—BIDS ON PALESTINE PIPE SEWERS.

Quantities	Engineer's Estimate		Embankment Co. Joliet, Ill.		A. House & Co. St. Louis, Mo.	
3,130 ft. 12-in. tile sewer avg. cut 9.0 ft.	$1.00	$3,130.00	$1.04	$3,047.20	$1.15	$3,599.50
3,900 ft. 10-in. tile sewer avg. cut 8.3 ft.	.75	2,925.00	.81	3,159.00	.90	3,510.00
15,450 ft. 8-in. tile sewer avg. cut 7.0 ft.	.55	8,497.50	.63	9,733.50	.65	10,042.50
73 brick manholes	27.50	2,007.50	44.00	3,212.00	40.00	3,504.00
10 flush tanks	75.00	750.00	73.00	730.00	75.00	750.00
Total for sewer sy'tm.		$17,310.00		$19,881.70		$21.406.00

Sewerage Bids at Palestine, Ill.

Table I gives the engineer's cost estimate and bids by two construction companies on a system of pipe sewers for the town of Palestine, Ill. The bids were received on August 1 with the understanding that construction work was to begin on or before August 15. The work presented no unusual features. Trenches were all dug to full depth in dry sand.

The brick manholes mentioned in Table I are circular in section, 3 ft. in diameter. They are of two rings of brick, and average 7½ ft. deep. The flush tanks are of brick construction, 2 rings, 4 ft. in diameter and 5 ft. deep. They are equipped with 5-in. Miller siphons made by the Pacific Flush Tank Company, of Chicago. All the Palestine work was awarded to the Embankment Company, of Joliet, Ill.

Table II gives the bids on the Palestine sewage treatment plant. The drop manhole mentioned is 7½ ft. deep; the 200 ft. of 12-in. sewer first mentioned is in an 8-ft. cut and the other 200 ft. of 12-in. pipe is in 4-ft. cut. The concrete diversion chamber measures 4x8x10 ft., and the settling tank 15x 40x12 ft. The 200 ft. of 10-in. sewer is in 3-ft. cut. Besides the itemized bid on the sewage plant given in Table II there was a lump sum bid of $9,000 by Sell & Kollar, of Pana, Ill.

Bids on the Warsaw, Ill., Sewers

Table III schedules the bids made on the Warsaw, Ill., sewer system. These bids were received on June 26 and work has been in progress for over a month. All trenches were in clay. The pile supports mentioned were at the outlet. The average cuts on the various lines were as follows: 15-in., 7.2 ft.; 12-in., 12.9 ft.; 10-in., 8.6 ft.; 8-in., 8.5 ft.; and 6-in., 7.7 ft. The Warsaw contract was awarded to Harness Bros., South Ottumwa, Ia.

On all the work here mentioned W. S. Shields, Hartford building, Chicago, was consulting engineer.

TABLE II—BIDS ON PALESTINE SEWAGE TREATMENT PLANT.

Quantities	Engineer's Estimate		Embankment Co. Joliet, Ill.	
1 drop manhole	$ 27.50	$ 27.50	$ 55.00	$ 55.00
200 ft. 12-tile sewer	1.00	200.00	1.25	250.00
1 concrete diversion chamber with equipment	150.00	150.00		350.00
1 combined settling tank and dosing chamber	3,650.00	3,650.00		3,990.00
4 sand filters 40 ft. x 60 ft.				
4 sand filters 40x60x2 ft. concrete curb and drain.	525.00	2,100.00	900.00	3,600.00
200 ft. 12-in. outlet sewer plant to outlet ditch	1.00	200.00	1.00	200.00
200 ft. 10-in. sewer pipe connecting filters	.80	160.00	.70	140.00
205 yds. excav. in straightening ditch	.50	102.00	.50	102.50
Total		$6,590.00		$8,687.50

Good Results With Convict Labor

Municipal contractors in Omaha, Neb., have secured excellent results by the use of convict labor supplied by the city to make up for the deficiency in free laborers. A rate of 25 cents per hour per man was paid to the city, of which amount 10 cents went into the benefit fund which each convict receives at the expiration of his term. This labor is only supplied in such cases as cannot be taken care of by free labor.

Towns Pay State Road Tax

In a bill passed by the Rhode Island State Legislature provision was made for payment of special tax by cities and towns, this money to be used for building and improving highway. The new tax, added to the moneys now coming from automobile license fees and Federal aid, brings the total fund available for 1917 work to approximately $400,000.

TABLE III—BIDS ON WARSAW, ILL., PIPE SEWER SYSTEM.

Quantities	Engineer's Estimate		Harness Bros. So. Ottumwa, Ia.		Monie & Dunbar St. Louis, Mo.		U. B. Waters & Sons St. Louis, Mo.		Eiff & Simons Quincy, Ill.	
125 ft. of 15-in. wrought iron outlet pipe	$ 3.00	$ 375.00	$ 3.50	$ 437.50	$ 3.80	$ 475.00	$ 5.00	$ 625.00	$ 4.00	$ 500.00
Pipe supports		125.00		150.00		150.00		200.00		150.00
670 ft. of 15-in	1.20	804.00	.935	626.45	1.40	938.00	1.25	837.50	1.40	938.00
3,280 ft. of 12-in	1.10	3,608.00	.88	2,886.40	1.20	3,936.00	1.20	3,936.00	1.20	3,936.00
2,600 ft. of 10-in	.85	2,210.00	.735	1,911.00	.85	2,210.00	.90	2,340.00	.85	2,210.00
14,590 ft. of 8-in	.65	9,483.50	.655	9,556.45	.65	9,483.50	.60	8,754.00	.65	9,483.50
4,650 ft. of 6-in	.50	2,325.00	.50	2,325.00	.50	2,325.00	.45	2,092.50	.50	2,325.00
90 brick manholes	30.00	2,700.00	40.00	3,600.00	40.00	3,600.00	50.00	4,500.00	45.00	4,050.00
Total		21,630.50		21,492.80		23,117.50		23,285.00		23,592.50

PAVEMENT CLEANING AND MAINTENANCE

Present Practice and Regulations Pertaining to Pavement Openings

By Arthur H. Blanchard, Consulting Highway Engineer, New York City, N. Y.

Pavement openings are primarily due to the installation, extension and repair of such subsurface structures as sewers, street railway track accessories, pneumatic tubes for mail services, subways, and pipe for water, steam, gas, telephone, telegraph and electric light wires. The magnitude of the pavement opening problem is readily appreciated when it is noted that in one year the city of Boston issued 15,696 permits covering a total combined length of openings of 1,014,807 feet, or about 193 miles.

The present unsatisfactory status of pavement openings in many municipalities of the United States is due to one or more of the following contributing causes: (1) Lack of centralized administration; (2) inadequate supervision by highway departments; (3) utilization of inefficient organizations and methods for back-filling trenches, making temporary surface repairs, and final replacement of artificial foundations and pavements.

Administration and Organization.

Present practice in administration and organization governing pavement openings varies from absolutely no control by a city official to a thoroly organized administration, such as is found in the cities of Cincinnati and Philadelphia, for example. In Cincinnati it is unlawful for any person, firm, corporation or city department, other than the street and sewer repair department of the department of public service, to make openings unless a permit is obtained. Philadelphia, with its perfected organization of experienced engineers and inspectors, under the permit division of the bureau of highways, has an efficient workable plan of control which is worthy of investigation and duplication.

Lack of knowledge of subsurface structures in the majority of municipalities is recognized by municipal authorities. Recently endeavors have been made in several municipalities to remedy this condition. The practice of the boro of Brooklyn of New York City, Philadelphia and Houston, Texas, are cited as examples. In Houston all persons, firms or corporations owning pipes, etc., were required to file with the city, within ninety days after the passage of the ordinance, a map on a scale of 200 feet to one inch, which showed the exact location, size and description of its mains, laterals and other subsurface structures, and furthermore, in each year within fifteen days after January 1 a corrected map or set of maps must be filed.

In many cities it has become the practice to post notices on highways to be paved or repaved and to forward such notices to all property owners residing on streets to be improved and to persons, corporations and city departments who control subsurface structures on such streets. As an example of such notices, that issued by the city of Baltimore is herewith quoted:

"You are hereby notified that the street bounding this property is to be paved with improved pavement and that the work will commence shortly after six weeks subsequent to the date of this notice. All necessary underground construction for installing or repairing gas, water, electric and other subsurface structures must be done before the street is paved. No permits to cut trenches or to disturb the pavement will be issued. Notice to the above effect has been given by public advertising."

The ordinance of the city of Cincinnati states that no permits will be granted within a period of three years after the construction of pavements except on account of emergencies.

Permits and Payments for Reconstruction.

Practically all municipalities with over 50,000 inhabitants require some form of permit of a person or corporation desiring to make an opening in a pavement. In many cases, however, the securing of a permit is a mere formality, as in the case of one municipality of 250,000 inhabitants, whose ordinance only requires for the permit a payment of $2.00 and notice in writing to the commissioner of public works that an opening is to be made. On the other hand, several municipalities require compliance with definite and adequate regulations. As an example, the following excerpts from the ordinances of Pittsburg are mentioned: The application for a permit must contain a complete detailed description covering location, size of openings, nature of substructures, etc.; a bond of $500 for one opening and $2,000 for an indefinite number of openings must be filed; a deposit to cover the cost of repaving must be made.

The amount of deposit required with a permit varies to a remarkable degree. Some municipalities have adopted a logical basis of charging the cost of repaving plus a certain percentage for inspection and other overhead charges. In the case of the city of Seattle, where all repairs, after the trench is opened, are made by department men under the direction of the superintendent of streets, a deposit is required based on the following rates: Two dollars and fifty cents for each cubic yard of earth filling; $5.00 for the first square yard of pavement; $3.00 per square yard for each additional square yard broken up. Upon the basis of a signed statement by the superintendent of streets, the city treasurer pays back unexpended part of deposit, retaining 10 per cent. of actual cost for overhead charges; a utility company may, however, deposit $500 for cost of repairing street openings, renewing same as required.

It should be noted that many cities have adopted a schedule of rates of repaving, dependent upon the kind of artificial foundation, type of pavement and the yardage of opening. For example, Schenectady, N. Y., makes the following charges for artificial foundations and pavements: Asphalt, brick or granite block, $10.00 for the first square yard and $3.00 for each yard thereafter; for macadam, $3.00 for the first yard and $1.00 for each yard thereafter.

In this connection it has been recommended, in the case of Richmond, Va., that the ultimate cost of installation of lateral connections by public utility companies would be materially reduced if all lateral connections, the usefulness of which could be predicted, were made prior to the time when the street was paved or just before a street was paved.

Back-filling, Artificial Foundations and Repaving.

Great variation is found in the practice of American municipalities with reference to making repairs of openings by city departments, contractors or public utility companies. In some cases all repaving work is done by the permittee. In Albany, for example, public service corporations open, backfill and repave; while in other instances, back-filling and repaving are done under the direction of the commissioner of

public works. Many municipalities allow the permittee to open and back-fill, artificial foundations and pavements being constructed by city departments. In a few instances, as in the case of Seattle, the city does all the work with experienced men, the result being that openings are repaired in an efficient manner and very little trouble results thereafter. It is well to note that the public utility companies of Seattle appreciate having the work done by experienced employes of the municipality, thus relieving them of responsibility in connection with repairs.

Inefficient control and methods of back-filling are the cause of a very large percentage of the troubles arising from pavement openings. Even with the accumulated knowledge and experience now at hand, many municipalities today allow back-filling to be made by the inefficient method of merely shoveling in as much material as the trench will hold. Advanced methods of back-filling are, however, in use in many municipalities, where it is required that all material excavated, except rock, shall be placed in the excavation, thoroly tamped in layers of from 3 to 6 inches, or flushed if the materials and other conditions are suitable for this method of compaction.

Houston, Texas, goes a step farther and requires that trenches under pavements shall be refilled with well-rammed gravel, broken stone or brickbats, or refilled with tamped earth and covered with a reinforced concrete (1:2:4) slab, which must project 12 inches on each side of the trench and have a depth of 10½ inches for a 2-foot opening, increasing to 15 inches for a 6-foot opening.

In several municipalities, it is required that the cement-concrete foundation shall be cut back for 6 inches on all sides of the opening and be replaced by new cement-concrete, thus forming a slab to bridge over the trench.

Conclusions.

Based on observations of practice in many municipalities thruout America and Europe, the following conclusions are submitted as applicable to general conditions found in municipalities thruout the United States.

Administration and Organization.

Pavement openings should be absolutely under the control of the chief of the bureau of highways; all persons, corporations and other city departments being required to secure permits from the highway department prior to making openings in pavements, except where emergency conditions require such openings to be made in the interests of public health and welfare.

Notices should be advertised, posted and sent to all interested parties, giving ample warning in cases where streets are to be paved or repaved and containing the provision that charges to the permittee will cover cost of back-filling, but not artificial foundations and pavements. The practice of not allowing pavement openings to be made within a certain period after a payment is laid is believed not to be in the interest of public progress and is unnecessary if the notice advocated is given and efficient methods of control, back-filling and repaving are adopted.

Plans of subsurface structures on all streets should be compiled and permits should be granted only after accurate and detailed information has been filed pertaining to all details of substructures in connection with the given pavement opening.

Deposits should be required covering cost of back-filling, reconstructing artificial foundations and repaving, which should be based on a schedule of rates dependent upon the character of back-filling, type of artificial foundation, kind of pavement and yardage of the several items. An adequate percentage should be added to the cost of the above items to cover supervision and other overhead charges.

After a permit has been granted, excavation should be made by the permittee, and back-filling and repaving done under the supervision of engineers of the highway department and by a flying squadron of experienced men in the employ of the department.

Back-filling and Artificial Foundations.

All material excavated, except rock, should be replaced in the trench and, in the process of back-filling, the material should be thoroly compacted by hand or mechanical tampers, or with the aid of water used sparingly, dependent upon the character of soil and kind of pipes. The wise saying of an old road foreman, that two tampers are required for every shoveler in order to secure satisfactory compaction, should be borne in mind in organizing the flying squadron of experienced laborers.

Except in the case of water-bound gravel and broken stone roads, cement-concrete foundations over trenches should be constructed, and such foundations should extend 6 inches beyond each side of the trench and have a depth of not less than 8 inches. If the methods outlined above are adopted, it is not necessary to postpone repaving, provided climatic conditions are satisfactory for such work.

If temporary repaving is, for any reason, necessary, it is recommended that the back-filling, as above outlined, be carried to the elevation of the top of the artificial foundation and that such materials as small stone blocks, paving bricks laid flat, asphalt block seconds, or hot or cold bituminous concrete should be used for a temporary wearing course.

Repaving.

In the process of repaving, it is recommended that the old pavement be cut back 3 inches on each side of the new cement-concrete foundation. The adoption of this plan will eliminate planes of weakness and will insure the practicability of making an efficient bond with the old pavement.

Sidewalks.

The ground beneath sidewalks in municipalities should be kept clear of vaults and other accessories of buildings. The space under sidewalks should be reserved for the possible future installation of pipe systems which would relieve present congestion of subsurface structures in the carriageway and reduce the number of openings made in pavements.

Maintaining New York Roads

A large part of the roads of New York have been maintained by patrolmen, each in charge of four to seven miles of road. There has been some question whether this method of maintenance was as satisfactory and economical as that of allowing the road to become somewhat worn and then restoring it by the labor of a gang of men. During 1916 the relative merits of the two systems were tested under the direction of Fred W. Sarr, second deputy highway commissioner, who found that the gang operated with greater efficiency provided it had work enough to keep it busy. But such efficiency in repairs was offset in some degree by the relative convenience to the traveling public of the two systems. The patrolman keeps the road in good condition all the time, by applying practically the old axiom that "a stitch in time saves nine." If he is not employed the road falls into the condition when nine stitches must be taken to restore it, which means that there will be nine ruts or holes for the traveler to jolt over before the surface is made true again, instead of merely a single little rut or depression. Consequently, while the patrolman may be said truly to maintain the road, the gang does not actually maintain it, but rather repairs it. When the road is surfaced with first-class concrete or brick, however, the experience in New York shows that the maintenance is best done by gangs, for the effect of traffic on such roads is different from the effect on water-bound macadam and gravel.

SEWER DESIGN AND CONSTRUCTION

Designing Inverted Sewer Siphons

By Joseph L. Hunt, Assistant Division Engineer, Public Service Commission, First District, New York City.

Altho the so-called inverted siphon has been used for a number of years in New York City, it seems that but little literature concerning this type of sewer has been available. The writer has been in direct touch with the work of constructing these sewers and is outlining below the principal features in connection with them.

Inverted Siphon Misnamed

The inverted siphon is misnamed, because it is not a siphon in the true sense of the word, but is simply a sewer which runs under pressure, due to its deing depressed under some obstacle in its path, and is similar in its operation to a running trap in common use on all house drains. A true siphon is an upward deviation or bend over and above the hydraulic gradient in a pipe or conduit thru which a liquid is forced due to atmospheric pressure. The only point of similarity between an inverted siphon and a true siphon is that the outlet must be lower than the inlet. In true siphons air and gases are liable to collect at the summit, thereby destroying the action of the siphon, and for continuous successful operation require the installation of some mechanical device to free this air of gases, on account of which they are prohibitive for practical sewer purposes.

A number of true sewer siphons have been constructed in Europe, notably in Breslau and Potsdam, in Germany, and one over the St. Martin canal, in Paris, and are operating successfully, but they will never come into general use, owing to their unreliability and necessary constant attention and maintenance.

Elements of Inverted Siphon

An inverted siphon consists essentially of pairs of vertical or inclined pipes, with a horizontal or graded pipe or conduit passing under the obstruction, joining their lower extremities. The vertical pipes of the inverted siphons commonly constructed in the past were usually large enough for a man to enter, with a sump at the bottom for the collection of heavy material, which otherwise would clog the pipes. Where inclined pipes were used special manholes were sometimes built at the lower bends to facilitate cleaning.

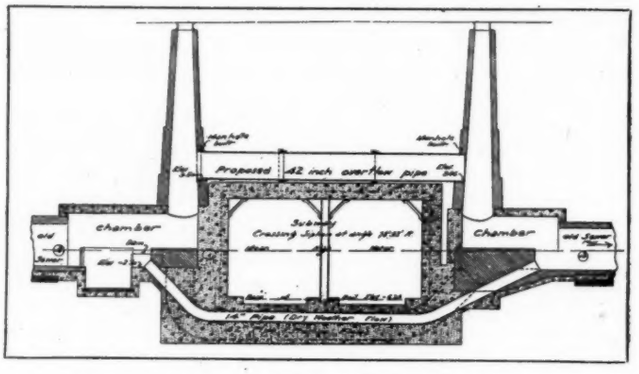
Owing to the number of inverted siphons it has been necessary to construct in connection with the subways, a careful study has been made of this type of sewer, and their operation has been closely watched to reveal their defects, in consequence of which improvements have been made from time to time, with the result that the inverted siphons which are now being constructed are the best that this study and experience can produce.

The type of siphon adopted by the Public Service Commission consists of separate pipes for the dry-weather and storm flow, the reason for which the writer will explain later.

First One Built in 1900

In connection with the construction of the first subway in 1900 a large trunk sewer was intercepted by the structure at 149th street and Railroad avenue, in the Bronx. One of two things had to be done—either the subway depressed to pass under the sewer, or the sewer depressed under the subway. The former proposition would greatly have increased the cost of subway work in this location, owing to the increased depth of excavation below mean high water for a considerable length, and it was therefore decided to depress the sewer. But this was not to be easily done. The invert of the sewer is 2.2 ft. below mean high water, and to carry it under the subway it would have to be lowered at least 10 ft., which is too low for a gravity outlet. A pumping station was considered, but this meant, in addition to the initial cost, a fund for maintenance, repairs and replacements, and the city would not be saddled with this burden, which left as the only solution the construction of an inverted siphon.

Very little was known about the inverted siphon at the time, and grave doubts were expressed about its feasibilty in a built-up section of the city where a possible and probable stoppage of the flow would cause untold damage.



INVERTED SIPHON AT 149TH STREET AND RAILROAD AVENUE, THE BRONX.

But in spite of threatened failure, the Public Service Commission's sewer engineers decided to give it a trial, believing that if the pipes of proper size were used so as to maintain a cleansing velocity the objectionable feature would be overcome. In this connection it is well known to all that the dry-weather flow in sewers is very small in comparison with the storm flow, and moreover, it is this flow which has to be considered for the greater period of time, and it is this fact which prompted the idea for the different sizes, and the 149th street siphon is, the writer believes, the first of its type to be constructed.

How Sizes Were Determined

The writer is going to explain in a general way how the sizes of the pipes are determined and also some of the other essential features of their design. The principle of the inverted siphon is that simple one in elementary physics of water seeking its level. But simple as is the principle, the design for successful operation is somewhat complicated due to details to prevent clogging and facilitate cleaning.

To get the size of the small or dry-weather pipe the drainage area is measured on a city sewer map drawn to the scale of 300 feet to the inch by means of a planimeter. The estimated population of this area is then obtained from the census records. In a built-up section this varies from 100 to 500 persons per acre; the water consumption for this area is also obtained from the Department of Water Supply, Gas and Electricity records; this is found to vary from 50 to 120 gallons per capita. It is this water, or what is known as spent water,

which constitutes the dry-weather flow. A generous allowance is made for infiltration and for the future growth of the section, and from these figurese the number of cubic feet per second per acre are computed. Having this quantity and assuming a minimum of say 5 ft. per second, there is obtained by substitution in the simple hydraulic equation, Q=AV, the value of A, or the area of cross-section of the pipe required. The nearest commercial size to this area is used.

By actual measurements in the sewer at 149th street, and by means of the calculations mentioned above, it was found that a 14-in. pipe running full would take care of the dry-weather flow and two 42-in. pipes would take care of the storm water.

First Sewer Without Defect

After this inverted siphon had been in use for about seven years, during which time it was under the control of the city sewer department, an investigation was made to determine what trouble it had caused, what it had cost to maintain and what defects, if any, could be remedied in future construction. About this time a number of similar sewer conditions had arisen in connection with the Fourth avenue subway in Brooklyn, and the sewer authorities of that boro were still opposed to inverted siphons.

Much to the satisfaction of the Public Service Commission, it was found that this inverted siphon in the Bronx had not caused the least trouble or annoyance and had not been cleaned in the entire seven years of its operation, which was very encouraging to the chief engineer of the commission, and he authorized the engineers to proceed with the design and construction of six additional inverted siphons on the Brooklyn work. In connection with the investigation of the 149th street siphon a number of observations and measurements were taken to determine the actual velocities thru the pipes at different times and the effect of the tides on these velocities. One of the storm pipes was also pumped out and examined, and it was found that, with the exception of a few paving blocks which in some way got into the sewer, the pipe was practically clean.

No Sumps Used

The engineers engaged on this investigation recommended the abandoning of the sump in the up-stream chamber as being unnecessary. These sumps fill up in a short time and then fail to serve their purpose in catching heavy objects, such as bricks and paving blocks, which find their way into sewers. The investigators also recommended that the dam in front of the storm pipes in the up-stream chamber should be raised a little higher on account of the tides and that a similar dam be constructed in the down-stream chamber to keep the sanitary flow out of the storm pipes, as this caused a thick scum to form on the surface of the water standing in the storm pipe between storms, which, thru septic action, gave off foul odors.

These recommendations were adopted in connection with the Brooklyn siphons and new features were added for cleaning the dry-weather pipes and in the construction of the chambers. These features include a clean-out manhole at one of the lower bends of the dry-weather pipe, where a short special split pipe is located, with the upper half removable for cleaning in case of necessity. In these inverted siphons the chambers are simplified and all changes in direction are made with easy bends and curves where possible to eliminate all unnecessary losses of head.

Screens Not Practicable

During the construction of these inverted siphons a suggestion was made to place a screen of bars in the sewer at the approach to the siphon to keep out large floating materials. To test the practicability of this suggestion a temporary wooden screen was set up in a 5-ft. 9-in. by 3-ft. 10-in. egg-shaped sewer leading to one of the Brooklyn siphons. This screen consisted of 1-in. by 1-in. vertical strips spaced 8 inches center to center, to which were nailed four horizontal strips 6 inches apart, thus making the opening 6 inches by 8 inches. The screen was set vertically in the sewer by wedging it between the arch and invert, and was left there for nearly two days, when it was removed to be photographed. It was completely covered for the depth of the flow with rags, paper, twine, wood and other debris, effectively blocking the flow, and showing conclusively that any such device would form a dam in a very short time. Mechanically rotated screens, such as are used in sewage purification plans, would serve the purpose, but could not be used owing to the cost of maintenance.

Siphons Reduce Cost

After the construction of these Brooklyn siphons, which were completed during the year 1911, the next similar work was met in connection with the Broadway-Lexington avenue subway. The successful and uninterrupted operation of all the siphons constructed in the past prompted the engineers of the commission to become bolder in their undertakings and more confident in their design. This was evidenced in the construction of the 110th street siphon under the Lexington avenue subway, which is the largest ever built in connection with subway work. The 110th street sewer which it replaces is a horse-shoe section, 8 ft. high by 12 ft. wide. To have lowered the subway sufficiently to allow the sewer to cross over the roof would have entailed an additional cost of $800,000 and to divert the sewer elsewhere would have involved an expenditure of $1,200,000, and, moreover, on account of its flat grade, would have required an excessive maintenance cost. The solution adopted consisted in the construction of two inverted siphons, one at 106th street and the other at 110th street, both crossing under the Lexington avenue subway, at a combined cost of $71,000 and a maintenance charge probably little in excess of any other sewer.

Publications Received

Hubbard's Laboratory Manual, $1.50 net. John Wiley & Sons, New York.

"Municipal Engineering Practice," by A. Prescott Folwell, is a book of 422 pp., published by John Wiley & Sons, for $3.50 net on practice in municipal lines other than street paving, water supply and sewerage, which are treated in three other books by the same author.

"Standard Methods for the Examination of Water and Sewage," adopted by the American Public Health Association, are published by the association in a cloth-bound book of 115 pp., for $1.25. The third edition is just issued as revised to April, 1916. Address 126 Massachusetts avenue, Boston, Mass.

"Municipal Functions," by Herman G. Jones, J. D., Ph. D., is a volume in the National Municipal League series, edited by Clinton Rogers Woodruff and published by D. Appleton & Co., New York. Cloth, 369 pp.

"Town Planning for Small Communities," by Charles S. Bird, Jr., chairman of the Walpole, Mass., town planning committee, is a volume in the National Municipal League series, edited by Clinton Rogers Woodruff, and published by D. Appleton & Co., New York. Cloth, 492 pp.

"Paving Economy, Road and Street," is a paper-bound book of 98 pages, by Charles A. Mullen, director of the paving department of the Milton Hersey Company, Montreal, Que., the argument of which leads to the asphalt pavement.

"Public Utility Rates," a discussion of the principles and practice underlying charges for water, gas, electricity, communication and Transportation services, by Harry Barker, B. S. Cloth, 387 pp., $4. McGraw-Hill Book Company, New York.

PAVEMENT DESIGN AND CONSTRUCTION

Methods Employed in Hurried Road Construction at Mount Gretna (Pa.) Military Camp

Plans for road building at the Mount Gretna camp contemplated the completion each week of two miles of water-bound macadam road 16 ft. wide. The total length of the road is 6½ miles. George H. Biles, Second Deputy State Highway Commissioner, in direct charge, was five days ahead of schedule when a five-day rain set in.

Machinery and Blasting

There are 300 laborers living under tents erected according to military regulations. The State Highway Department equipment on the ground includes 12 traction engines, 10 rollers, 13 scrapers, 31 dumpwagons, 22 auto trucks, 7 rooter plows, 9 sprinklers, 1 scarifier, 4 harrows, 4 drag scoops and 1 gasoline pump. At the time of writing 20 car-loads of material are arriving on the job daily.

The slag pile at Lebanon was practically commandeered. Effort to blast the crust of the slag with dynamite were abandoned as the dynamite spread its force through the loose slag under the crust. A well-drilling outfit was put in and, after drilling holes thru the hardened crust and the loosened slag, successfully broke up the mass with black powder.

Construction Methods Employed

The hurry-up construction methods employed are described as follows by Second Deputy State Highway Commissioner Biles:

Clearing and Grubbing

The work embodies principally the complete opening up of new right-of-way, which requires that various operations must be carried on in order, namely, the section must first be brushed, trees removed and stumps and rocks blasted out before the actual grading work can be taken up. Upon some of the sections this work is of magnitude and requires a large organization to accomplish satisfactory results. When the right of way has thus been cleared, traction engines, with rooter plows, are started in completely to loosen up the surface. This is followed by traction engines and road machines, or graders, which complete the removal of the necessary material to the grade lines.

Preparation of Subgrade

All craters left by the removal of stumps and large rocks are filled with stone in order to ensure a solid subgrade. Drains and culverts then are placed at the proper locations and after this the large power rollers are put in operation and the surface is thoroly compacted. Upon the sub-base, after being properly prepared, the slag, which is being used for the base construction, is deposited in the center of the road in continuous stretches. This material is spread in two layers by these machines, which are drawn by traction engines, each layer being thoroughly rolled, and upon completion being about eight inches in depth.

With the final rolling of the slag base, the surface of the slag is sprinkled, which tends to solidify, or cement, the material more uniformly. Upon this surface is deposited, in continuous piles along the center of the road, the same as was done with the slag, trap rock ballast. This also is spread in place with the use of traction engines and road machines, to a depth of about 5 in.

Placing First Course

When the proper amount of material is secured and the spreading is completed, a spike-tooth harrow, weighing about 400 lbs., is drawn over the surface of the road, back and forth, which segregates the stone and eliminates the possibility of loose pockets. This operation is continued until the teeth of the harrow practically ride on the upper surface of the stone. Stone screenings then are spread lightly from piles at the sides and followed by sprinkling and rolling alternately, adding the necessary amount of screenings during the operation, in order to bond up the ballast stone thoroly. This course is 4 in. in depth when compacted. The rolling and sprinkling are continued until a surface mortar is produced and the road shows no wave under the operation of the roller. When this is completed, the surface then is to be opened to traffic for a few days and thereafter given an additional rolling and finishing, in order to compact uniformly and completely all portions of the surface.

Finished Surface

Upon the finished road surface, after the fine material has been swept off, a bituminous treatment of four-tenths of a gallon to the square yard is applied with motor pressure distributor, using Department Class "C" specification material, and covered with trap rock chips in quantities ranging from 15 to 20 lbs. to the square yard, applied with mechanical spreaders.

Recommended Changes in Testing Road Materials

Certain changes in the approved methods of testing road materials were recently recommended by Committee D-4 of the American Society for Testing Materials.

Standard Test of Rock Toughness

As the result of over nine years experience in routine testing laboratories and of a considerable amount of investigative work, it has been thought desirable to revise the present standard test for toughness of macadam rock, giving more complete and specific directions in connection therewith, and at the same time making the test more serviceable for ascertaining the relative toughness of different rocks. The committee recommends a revised test in Appendix I of the report which can be obtained from Provost Hubbard, secretary of Committee D-4, Office of Public Roads and Rural Engineering, Washington, D. C. Other appendices here mentioned may be obtained in a similar manner.

Testing Specific Gravity of Coarse Aggregates

In its 1916 report, Committee D-4 proposed a standard test for the determination of the apparent specific gravity of homogeneous coarse aggregates which was published as tentative. While it is believed that this test is satisfactory for aggregates which are absolutely homogeneous, recent investigations have demonstrated that the homogeneity of an aggregate is frequently difficult to ascertain, a revised tentative test is recommended in Appendix II of the full report. The revised tentative test is suitable not only for homogeneous but also for non-homogeneous coarse aggregate.

Distillation of Bituminous Materials

In 1916 the society adopted a standard method for the distillation of bituminous materials suitable for road treat-

ment. This method describes and specifies the thermometer which is to be used in the test in view of the fact that a number of committees have recommended specifications for distillation thermometers which do not defer materially in essential requirements, but only in wording and minor details, a conference committee was appointed to consider the existing specifications for distillation thermometers, and to present, if possible, a single specification to replace the three previously reported. Revised thermometer specifications are given in Appendix III.

Standard Definitions of Terms

The Joint Conference Committee has given further consideration during the past year to the terms, Aggregate, Bank Gravel, Screen and Sieve, and has proposed the following definitions, which have been accepted by Committee D-4, and are recommended for publication as tentative for the customary prescribed period before referring them to letter ballot of the Society:

Aggregate: The inert material, such as sand, gravel, shell, slag or broken stone, or combination thereof, with which the cementing material is mixed to form a mortar or concrete.

Screen: In laboratory work an apparatus, in which the apertures are circular, for separating sizes of material.

Sieve: In laboratory work an apparatus, in which the apertures are square, for separating sizes of material.

Bank Gravel: Gravel found in natural deposits, usually more or less intermixed with fine material, such as sand or clay, or combination thereof; gravelly clay, gravelly sand, clayey gravel and sandy gravel, indicate the varying proportions of the materials in the mixture.

In addition to its recommendations relative to the adoption of the revised standard method of determining the specific gravity of coarse aggregates and the definitions above given, the Joint Conference Committee reports that it has under consideration methods proposed by Committee D-4 for the determination of the specific gravity of sand and other fine highway material, and of voids in mineral aggregates; that it also has under consideration definitions for filler, grit, loam, screenings, and silt. The committee recommends that no definitions be adopted for Gravel, Sand and Clay, and this recommendation has been accepted by Committee D-4. Because of the fact that the interests of both committees are affected by the matter, the Joint Conference Committee has under consideration the standardization of methods for sampling gravel, sand, and similar materials.

British Standard Nomenclature

In view of the fact that the Engineering Standards Committee of Great Britian has published a report upon British Standard Nomenclature of Tars, Pitches, Bitumens and Asphalts, these with comments thereon were referred to the committee for consideration. In Appendix IV of the full report there is a discussion of the British Standard Nomenclature as compared with the nomenclature adopted by the American Society for Testing Materials.

Keep Up Road Work

Our entering into war need not and should not mean a curtailment in road construction and building operations. War does not mean that everybody should forget business and live a life of gloom. Both public and private useful construction ought to proceed. Production and handling of building materials and public and private construction work are fundamental industries of the country. The country is prosperous. Railroads should spare no effort to supply the building industry with the cars needed to transport materials. Government, state, county and municipal authorities should encourage the continuance of all kinds of building. Road and street improvements in particular should go on unabated.

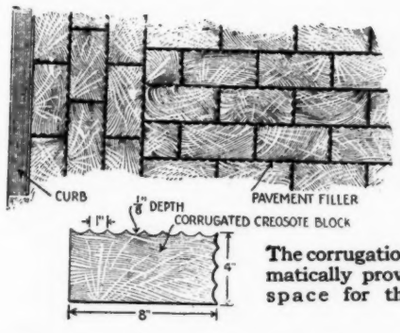
Contractors should make a careful study of conditions that they may encounter and lay plans accordingly. All work possible should be done by labor-saving devices. What may seem a heavy initial expenditure for equipment will very probably prove to be a wise investment before the contract is completed. It is worse than folly to use slow, costly methods.

Joints in Concrete Roads

Road builders have been laying concrete roads for a number of years, but they still differ radically regarding the necessity of leaving joints across the roadways every 30 to 50 ft. to permit the concrete to expand and contract with temperature and moisture changes without cracking. Some engineers believe that these joints do not prevent cracking and that it is better to lay the concrete without joints except where the day's work ends. They believe that the cracks in well-built roads are unimportant, and the most serious objection to them is the appearance of the black streaks across the gray concrete where the cracks are filled with bituminous material and sand by the repairman. They consider that joints merely add to the number of seams that must be filled with this material. The public riding over roads with these black streaks is liable to think that the pavements are failing when they are merely showing the natural effects of the expansion and contraction of concrete. There are more engineers, however, who hold that joints should be left at regular intervals. They are placed about every 30 ft. apart in Connecticut, for instance, where the state road authorities believe that a straight, well-made joint can be much more easily cared for than any ragged crack which might result if no joints were used or if the distance between them were lengthened. The subject is of much interest to road builders, because it is one of those features of their work where only the experience of a number of years will give the knowledge to decide correctly what is the best practice.

Corrugated Wood Paving Block

An interesting step toward the betterment of wood block pavements has been taken by the Jennison-Wright Co., in the manufacture of a corrugated wood block for this work. Each of these blocks is corrugated at one side and one end, by grooves running parallel to the grain of the wood, as shown herewith. The dividing lines between grooves are of "knife-edge" sharpness.



The corrugations automatically provide the space for the filler

The particular advantages claimed in using these blocks in paving work come from the fact that the pavement will not buckle from heat, dampness or other causes that may make the wood swell. All movements of the blocks are absorbed by the compression of the corrugations. Being vertical the grooves also allow the tar filler to flow clear to the bottom of the block, thus sealing the pavement against moisture.

Comprehensive Survey of Deposits of Road-making Materials

An interstate Survey of road materials is under way with Dr. Wm. Bullock Clark, state geologist of Maryland, in charge of geological work, and Henry G. Shirley, chief engineer of the state roads commission of Maryland, in charge of the engineering work. The work is being done at the request of President Wilson to aid the Council of National Defense. The committee investigating road materials is called the Committee on Available Materials for Rapid Railroad Highway and Fortification Construction Behind the Front. The Atlantic and Gulf coast states are being surveyed. The survey, undertaken primarily for military purposes, will make available to the road builders of various localities complete information relative to materials suitable for their needs.

Committee Personnel

The members of the committee are:

Alabama—Prof. E. A. Smith, University; W. S. Keller, state highway engineer, Montgomery. Connecticut—Prof. H. E. Gregory, New Haven; C. J. Bennett, state highway commissioner, Hartford. Delaware—Dr. E. B. Mathews, Johns Hopkins University, Baltimore; James Wilson, highway commissioner, Wilmington. Florida—Dr. E. H. Sellards, Tallahassee. Georgia—Prof. S. W. McCallie, Atlanta; T. P. Stanley, state highway engineer, Athens. Louisiana—Prof. F. V. Emerson, Baton Rouge; W. E. Atkinson, state engineer, New Orleans. Maine—Dr. H. P. Little, Waterville; Prof. W. E. Ford, New Haven, Conn.; Paul D. Sargent, chief engineer, state highway commission, Augusta. Maryland—Dr. Wm. Bullock Clark, Baltimore; H. G. Shirley, chief engineer, state roads commission, Baltimore. Massachusetts—Prof. B. K. Emerson, Amherst; Arthur W. Dean, chief engineer, state highway commission, Boston. Mississippi—E. N. Lowe, Jackson; Xavier A. Kramer, state highway engineer, Magnolia. New Hampshire—Dr. J. W. Goldthwait, Hanover; F. E. Everett, state highway commissioner, Concord. New Jersey—Dr. H. B. Kummel, Trenton; R. A. Meeker, state highway engineer, Trenton. New York—Dr. C. P. Berkey, New York; E. A. Duffey, state highway commissioner, Albany. North Carolina—Dr. Joseph Hyde Pratt, Chapel Hill; W. S. Failis, state highway engineer, Raleigh. Pennsylvania—Dr. R. A. F. Penrose, Jr., Philadelphia; W. D. Uhler, chief engineer, state highway department, Harrisburgh. Rhode Island—Dr. Charles W. Brown, Providence; I. W. Patterson, chief engineer, state board of public roads, Providence. South Carolina—Prof. Stephen Taber, Columbia; J. Roy Pennell, state highway engineer, Columbia. Virginia—Dr. Thomas L. Watson, Charlottesville; G. P. Coleman, state highway commissioner, Richmond. Texas—Prof. J. Udden, Austin; Prof. R. L. Morrison, College Station.

For a National System of Highways

All the states now have state highway departments and have adopted the policy of building state systems of main, thru-line highways. There is also a Federal Aid Road Act on the statute books. Therefore the stage is set for the final act—the establishment of a national system of highways. The next logical step is the broadening of federal participation to provide for the establishment of a system of national highways. This policy can be put into effect without disturbance of existing organizations, without providing new means of finance, and with but little change in existing law. In the judgment of Chairman George C. Diehl, of the Good Roads Board of the American Automobile Association, which was a pioneer exponent of national governmental co-operation with the several states, the process would logically take a course somewhat as follows:

First: The state highway departments and the Federal Office of Public Roads would make an initial selection from existing state highway systems of those highways which are of interstate importance.

Second: A system thus selected would be approved by Congress, with the requirement that federal funds be applied only to such system on and after a specified date.

Third: The federal aid should be extended to maintenance as well as construction, as the national system of highways should have for all time a close relationship to the federal government.

Some of the states have already made plans for utilizing the aid granted by the Federal Aid Road Act on roads which could not properly be included in a national system. But this need not cause extreme conflict, as the federal funds for the first three or four years' operation of the present act could continue to be applied as now planned. The appropriations for the first two years are already available and considerable time necessarily must lapse before the national system could be laid out and made ready for the application of federal funds.

In all probability the new scheme would come into effect as an extension of the present Federal Aid Road Act.

Resolutions Calling for Vigorous Road Building Campaigns

A large number of persons engaged in many professions and callings recently met at Columbus, under the auspices of the Ohio Good Road Federation, and, after a discussion of business conditions in both city and country, adopted the following concise statement of reasons for continuing road work:

Resolved, first, that the efficiency of our industrial, commercial and agricultural activities should not be lessened or handicapped by war hysteria.

Second, that our financial resources are in a healthy condition, no stringency in the money market exists, there is ample employment at good wages for all labor, that the agricultural districts promise an unusual acreage and harvest yield, that every pound of meat and bushel of grain the farm produces can be sold at profit prices, and that none of the factors that usually contribute to business depression now exists.

Third, that any policy of government that retards any useful activity will correspondingly harm other industries.

Fourth, that one great economic need of the farm and farmer is improved highways that will assist in transporting products of farm and garden to the market.

Fifth, that freight congestion in great centers of traffic creates imperative need for good highways to supplement railroads in transporting the products of the industrial and commercial world.

Sixth, that the war in Europe has already demonstrated that good roads are powerful adjuncts in national defense in the movement of armies, war munitions and all military supplies.

Seventh, that good roads are important factors in rural welfare, contentment and vitalizing of rural America; therefore, be it

Resolved, that this conference urge the national and state administrations, state highway department, county commissioners, county surveyors, township trustees and municipal councils to adopt and go forward with a vigorous, progressive road building program. We commend all county commissioners and road builders who have gone forward in road building and are doing their utmost to place Ohio in the lead in the improvement of highways.

WATER WORKS DESIGN AND CONSTRUCTION

Method and Progress of Lining the Wilson Avenue Water Tunnel of the Chicago Water Works

The Wilson avenue tunnel of the Chicago water works is one of the longest tunnels in the world and has many features which make it notable in regard to advanced methods of construction and the record rate of speed at which it is being constructed.

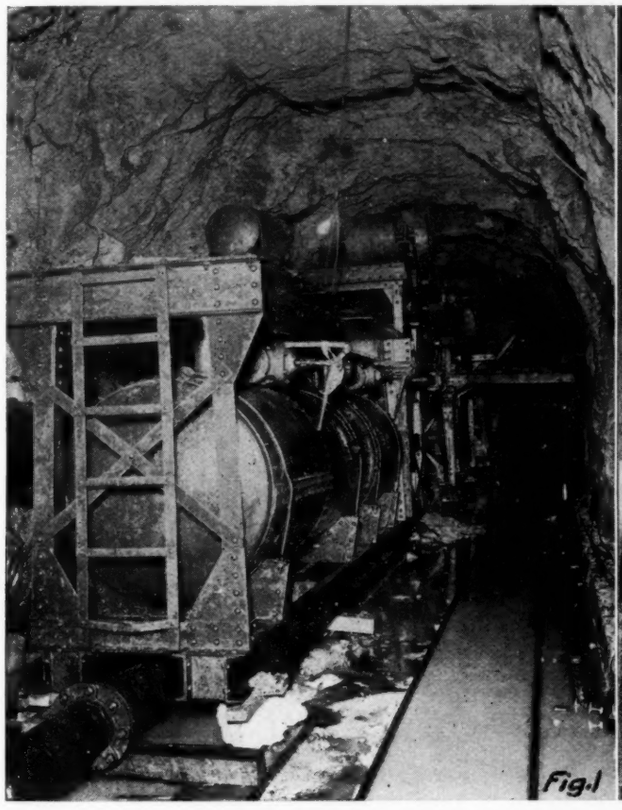
General Features

The tunnel is 8 miles long and 12 ft. in finished diameter for 7 miles of its length and 13 ft. in finished diameter for 1 mile of its length at the lake end. It is located in solid limestone rock about 150 ft. below datum and has a monolithic concrete lining, 1 ft. thick. The outer end of the tunnel is at the new crib in Lake Michigan, 3 miles from the shore at the foot of Wilson avenue. The west end of the tunnel is at the new pumping station at Mayfair, 5 miles west of the shore, and the land section of the tunnel is located directly under Wilson avenue.

The tunnel is being constructed by day labor, with the exception of the crib and about 2,000 ft. of tunnel from the crib west. The work being done by the city is handled thru four construction shafts, one at the extreme west end, the Mayfair shaft; one at Lawndale avenue, one at Lincoln avenue and one at the lake shore. These shafts are a little less than 2 miles apart. The heading east from the shore shaft is therefore about 3 miles in length and is one of the longest headings in the world to be excavated from one shaft.

Concrete Mixed and Placed by Compressed Air

In the early plans for the construction of the tunnel considerable study was given the method of handling the work of mixing and placing the concrete for the lining, as the rock excavated from the tunnel was good limestone and suitable for concrete work, and it was desirable that some method be employed whereby rock could be taken from the heading and used in the concrete without the necessity of removing the rock from the tunnel first and bringing it back again to be placed in the concrete lining. No tunnel had ever been lined in this way before, and it therefore required considerable study for the preparation of plans for a plant which could be used in the tunnel without interfering with traffic from the heading to the shaft, and at the same time utilize the rock direct from the heading.



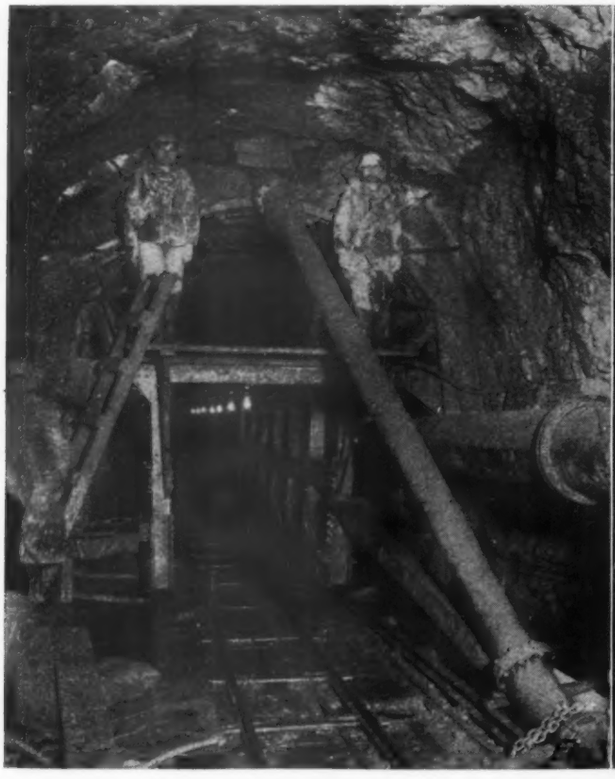
VIEW SHOWING LINING OF WILSON AVENUE TUNNEL OF THE CHICAGO WATER WORKS BY PNEUMATIC METHOD.
FIG. 1—SCREENING AND MIXING PLANT. FIG. 2—BLAW STEEL LINING FORMS.

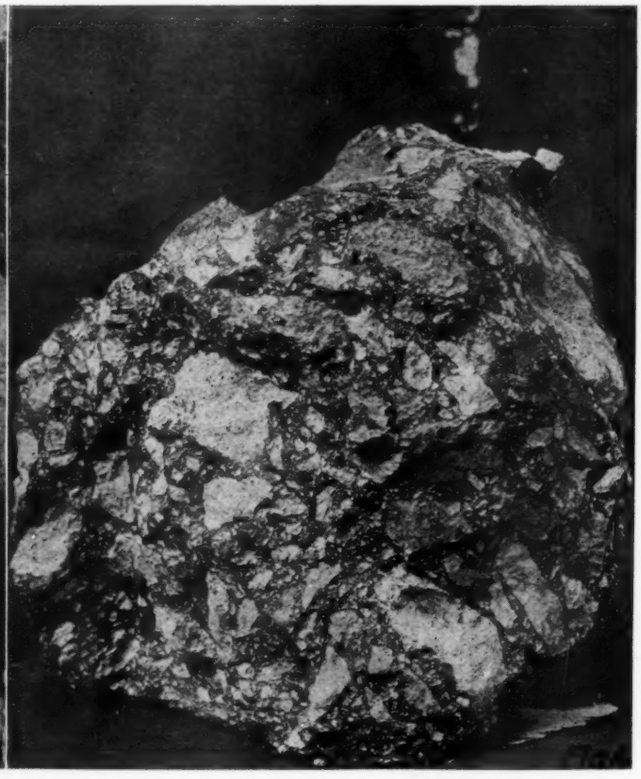
The Screening and Mixing Plant

The pneumatic method was decided upon for the work and a pneumatic mixer was mounted on wheels, together with air supply tanks and a measuring hopper located above it. In addition, a belt conveyor outfit, also mounted on wheels, was used to convey the rock from under the screen to the measuring hopper over the mixer. Upon the framework which held

this belt conveyor an electric winch was mounted for hauling 1-cu.yd. cars of mine-run rock up an incline, to be dumped over a flat screen with 4-in. holes. The rock which passed thru the holes fell onto the belt conveyor and was carried up to the measuring hopper. The rejections passed over the screen and fell onto an iron plate laid on the floor and were shoveled from this plate into a car to be hauled out of the tunnel. The entire outfit is shown in Fig. 1. It occupied only one track in the tunnel, so that the other track was never obstructed except by the car which received the rejected rock, and this car pushed to the shaft every time a muck train passed thru, and an empty car was placed in its stead.

The upper large pipe in Fig. 1 is the ventilating pipe carrying fresh air to the heading. The lower large pipe is the mixed concrete discharge pipe. To the left of the latter lies the 2-in. compressed air supply pipe line. The compressed air tank is prominent in the view. The platform at the top of the latter is used for handling the cement bags. This platform was extended across the tunnel section when the unit was set for a long run. The belt conveyor end is shown at the top of the unit.





VIEWS SHOWING LINING OF WILSON AVENUE TUNNEL OF THE CHICAGO WATER WORKS BY PNEUMATIC METHOD.
FIG. 3—PLACING THE CONCRETE. FIG. 4—SPECIMEN OF THE CONCRETE.

Forms and Placing

The general plan for proceeding with the concrete work involved the use of the pneumatic mixing plant, as described, and two Blaw traveling steel forms. One of these forms was set about 1,000 ft. away from the mixer and the other form about 500 ft. away—see Fig. 2. The 8-in. pipe for conveying the concrete from the mixer to the forms was laid along the side of the tunnel thru the first form to the second one, and there it was directed up a 45-deg. angle and into the top of the form as shown in the view, Fig. 3. When this form was filled with concrete, the pipe was disconnected and arranged for filling the other form, and as the concrete set the forms were moved alternately toward the mixer, until about 1,000 ft. of tunnel was completed. The mixer was then moved 1,000 ft. farther and the same operation was repeated.

The first pneumatic outfit was started working east from the shore shaft in December, 1915. At first a distance of 500 ft. was planned for conveying the concrete, but as this cycle was completed and the mixer moved to the next position, the distance was increased until the experience seemed to determine about 1,000 ft. as the proper maximum distance. The heading at this shaft was about 1 mile ahead of the mixing plant when the concrete work was started. With two 30-ft. forms the progress of the concrete work was about two and one-half to three times the progress of the excavation work, and this machine, therefore, caught up with the heading in about six months and was temporarily closed down until the heading was farther advanced.

In the meantime the heading from the Lincoln shaft was holed thru so that rock could be hauled from the heading east of the shore shaft to be used for the concreting plant which had been started at Lincoln avenue shaft in March, 1916. Accordingly, the concrete gangs from the two machines were organized into one gang, and one of the forms from the machine in the east heading was taken and set up for the Lincoln machine, thus making three forms to follow the Lincoln avenue machine and only one form for the shore shaft machine. This arrangement made it possible for one gang to operate the two mixers alternately, so that, working three shifts, they were able to fill the three forms at Lincoln avenue and one form at the shore shaft, keeping the concrete work going constantly on one of the two machines. As there were four forms in use, there was no delay caused by waiting for the concrete to set or waiting for the forms to be moved. Each shift the concrete gang found a form moved and the pipe connected up ready to start the concrete work. Each concrete gang completed one form and changed the pipe ready to start the next shift. There was a form-moving extra gang which worked one shift,

moving the forms and placing the sand-bag bulkhead at the forward end.

The machine at Lawndale was started in April, 1915, and the one at Mayfair shortly afterward. Both of these machines used rock from the heading east of the Lawndale shaft as the tunnel had been previously holed thru between the Lawndale and Mayfair shafts.

Concreting the Footing Wall

One of the new features of placing the concrete at the Lawndale shaft was the use of the pneumatic mixer for placing the concrete in the footing wall. This footing wall is usually built by hand in advance of the regular concrete work and is a wall about 1 ft. high, used as a guide for the forms to follow. In placing this at the Lawndale shaft the concrete was first delivered into the Blaw forms by the pneumatic mixers in the regular manner. But a keyplate was left out of the steel forms and a chute was placed in it, operating so that the concrete being placed by the pneumatic method would overflow thru the chute into a car placed beneath the forms under the chute. The car then carried the concrete ahead and dumped it into the forms for the footing wall. In this way the footing wall was placed about three times as fast as it could have been placed by hand.

Organization of Construction Gang

The number of men required for the operation of the concrete work was as follows:

Screening Rock from Heading—
- 3 men pushing up cars to incline, hooking on cable, dumping same on screen and pushing back empty cars to make train bound for the heading.
- 1 man operating motor hoist for pulling cars up incline and for operating belt conveyor for carrying screened rock to hopper over mixer.
- 2 men shoveling rejections from screen into cars to be hauled out of tunnel.

Cement Delivery—
- 2 men unloading cars of cement and storing same on platform above air tanks adjacent to mixer hopper.

Mixing and Placing Concrete—
- 3 men operating hopper over mixer, feeding cement, water and screen run rock.
- 1 man operating mixer, air valves.
- 1 man at end of pipe in concrete form.

When there was sufficient rock on hand for continuous concreting, the forms were filled very rapidly, one form having been filled in one hour and forty minutes. The forms contained from 50 to 70 yds. of concrete, depending upon the excavated section. During January, 1917, one machine at Lincoln avenue placed 2,707 lin. ft. of tunnel lining.

The progress of the work from the beginning of concreting operation is shown in Table I.

TABLE I—MONTHLY PROGRESS OF CONCRETING

Month	Yardage Placed	No. of Mixers
December, 1915	1,400	1
January, 1916	2,196	1
February	2,300	1
March	2,508	1
April	5,911	3
May	2,006	1
June	2,669	2
July	2,953	2
August	330	1
September	2,933	2
October	3,720	2
November	1,352	1
December	8,725	3
January, 1917	11,355	3
February	8,502	2
March	6,311	2
April	3,064	2
May	4,213	2
June	799	1

The rate at which the mixer operates cannot be figured from the data in Table I. Working between 16 and 24 hours a day, one machine, at the Lincoln shaft, put in 2,900 lin. ft. of tunnel in a month and the yardage of the lining runs 2 cu. yds. per lineal foot. The ultimate capacity of the mixer is 60 cu. yds. per hour. A sample of the concrete is shown in Fig. 4.

It should be noted that the Wilson avenue tunnel is the first tunnel in which the concrete work was carried on simultaneously with the mining and using the mine-run rock excavated from the heading for the concrete work. The use of the pneumatic method made this possible and saved over one year in constructing the tunnel.

Personnel

The pneumatic mixers are patented and are leased to the city by the Concrete Mixing and Placing Company, of Chicago. The work of constructing the tunnel is carried on by the Department of Public Works, Bureau of Engineering, Water Works Construction Division, with Mr. Henry W. Clausen in charge as engineer of water works construction. Mr. John Ericson is city engineer in charge of the Bureau of Engineering, and Mr. F. I. Bennett is commissioner of public works.

TRADE NOTES

Announcement is made of the removal of the San Francisco office of the Sullivan Machinery Company from the Sheldon building, 461 Market street, to the Hobart building, at 582 Market street. The manager of this branch office is Ray P. McGrath.

At a recent meeting of the board of directors of the Ingersoll-Rand Company, J. H. Jowett, formerly general sales manager, was elected vice president of the company. Mr. Jowett was succeeded in the position of general sales manager by L. D. Albin, formerly assistant general sales manager. Both of these gentlemen will continue to make their headquarters at 11 Broadway, New York City.

The Walter A. Zelnicker Supply Company, 325 Locust street, St. Louis, Mo., has just issued its new Bulletin No. 221, listing exceptional offerings in pipe, tanks, piling, rails, cranes, cars and locomotives. It is free for the asking.

Pauling & Harnishfeger, of Milwaukee, have orders booked that will keep their plant busy for nine months. They have only one 40-ft. 1-cu.yd. drag line, a couple of 12-ft. ladder type excavators and backfillers for delivery. A new lot of twenty-five tampers recently completed were half sold before they were finished. This is the last bunch to be put thru before snow flies. Any water department needing a tamper should get their order in now. P. & H. are quoting now for 1918 on excavators.

A preparation called "Rasindia," guaranteed to erase India ink from tracing cloth, is manufactured by E. H. Anderson, at 272 East 199th street, New York City. A 3-oz. bottle sells at $1. It is claimed that this erasing fluid leaves no trace of the ink and does not injure the cloth.

WATER PURIFICATION AND SEWAGE TREATMENT

Some Characteristics of the Activated Sludge Process of Sewage Treatment.

By Almon L. Fales, of Metcalf & Eddy, Consulting Engineers, Boston and Chicago.

The most recent development in the art of sewage treatment is the activated sludge process. This method of treatment is unique in that the process may be adapted to accomplish clarification without stability, or it may be carried to the point of producing a stable effluent without much excess of available oxygen, or it may be carried still further to the point of producing a highly nitrified effluent comparable with that from the intermittent filter, said Mr. Fales in an address to the American Chemical Society.

Requisites of Process

The requisites of the activated sludge process are:

1. A sufficient proportion of bacterially-active sludge.
2. Intimate mixture of the activated sludge with the sewage to be treated.
3. A supply of atmospheric oxygen ample for the bacterial demand.
4. A time of contact, or period of aeration sufficient to accomplish the desired degree of purification.
5. A temperature of aeration not too cold nor too warm for bacterial growth.

Activated sludge may be obtained by sufficient aeration of successive portions of sewage. A proportion equivalent to about 25 per cent. of the volume of sewage to be treated, is usually sufficient.

Intimate mixture of the activated sludge with the sewage may be secured by the proper application of the air which is required to support the bacterial life upon which the process depends.

The air must be uniformly distributed through the mixture, in order to supply all parts of the liquid with ample oxygen. A period of aeration of 4 hours appears to be sufficient for ordinary sewage. The indications are that about 1.75 cu. ft. of air per gallon of sewage will suffice under ordinary conditions.

Satisfactory results have been obtained even during winter weather, altho it appears to be difficult to secure nitrification at cold temperatures.

Means of Air Diffusion

Theoretically, at least, the air must be well diffused in order to be used economically, and as the compressed air is one of the chief elements in the cost of sewage treatment by this process, the question of air diffusion is a very important one. Porous plates—of such materials as filtros, corumdum and certain woods—are well adapted for the diffusion of air, but fear is expressed that such materials will become clogged in spite of all precautions, such as washing the air to be applied.

The concensus of opinion at the present time appears to be that something must be sacrificed in theoretical efficiency in favor of the more practical means, such as perforated pipes.

Theory of Action

Activated sludge is a light, flocculent substance, brown in color and earthy in odor. It contains large numbers of bacteria which appear to be essential to the process. When activated sludge is brought into contact with sewage, it will attract and absorb the suspended and colloidal matters and a portion of the dissolved matters, and submit them to bacterial oxidation.

The extent of oxidation of the absorbed organic matters will depend upon the period of contact afforded. It is possible, by lengthening the period of aeration, to secure a large percentage digestion of the sludge, occasioned by the transformation of organic matters into gases. It is possible to carry the aeration to the point of over-activation of the sludge, resulting in the disintegration of the sludge flocculi and a consequently muddy-appearing effluent.

Under-activation is characterized by a darker, more feathery and more voluminous condition of the sludge. If the sludge remains without sufficient air it will become disagreeable in odor, due to putrefaction, and will finally become deactivated.

Method of Operation

The activated sludge process is carried out in tanks operated either on the fill-and-draw plan or upon the continuous-flow principle. In the former case the tank is filled with the sewage, aerated for the required period of time and then allowed to settle, after which the clear, supernatent water is drawn off ready for the next tank-filling. In the latter case, sludge will be carried out of the aeration tank with the effluent and must be removed by sedimentation tanks and returned in proper proportion to the incoming sewage. It may be advantageous to reactivate the sludge so removed, before it is returned to the sewage.

Disposal of Activated Sludge

The activated sludge in excess of that required for the treatment, must be disposed of, and as the volume of such sludge is relatively large, the problem of its disposal is a serious one. Owing to its gelatinous nature and high water content——about 95 per cent.—it does not dry out as readily on sludge-drying beds as some other kinds of sewage sludge. After drying to a spadeable condition it is likely still to contain in the vicinity of 75 per cent. water. It may be readily filter-pressed to about the same water content.

Analyses of dried activated sludge indicate that it has greater fertilizing value than other sewage sludge, owing principally to a larger nitrogen content and a greater proportion of nitrogen available for plant food. Attention is now directed to the problem of dewatering and drying this sludge, at a cost which will either greatly reduce the cost of sludge disposal or actually make sludge disposal commercially profitable.

Interrupted Service Lowers Pump Efficiency

Tests made by A. O. Doane, division engineer of the Metropolitan water district of Massachusetts, show that small pumping stations usually work at a point considerably below the test efficiency, as a result of interrupted service and a load that is considerably under rated capacity.

Mr. Doane's test figures showed that in the smaller plants operating under capacity and working short hours the efficiency frequently fell to 75 per cent. or even 50 per cent. of that shown by test figures, based on the most favorable operation of the pumps.

Some Experiences in Operating the St. Louis Mechanical Filtration Plant

The design and constructional features of the big mechanical filtration plant at the Chain of Rocks station have often been described; the present article relates only to operating methods and experiences. The plant consists of 40 filter units, each of 2,800 sq. ft. of filtering surface.

Stages in the Purification Process

The raw water is pumped from the Mississippi river into a delivery well, flowing by gravity into a grit chamber. Here the velocity is checked and the heavy material deposited, after which the water flows into an 8,000-ft. mixing conduit. On entering this conduit milk of lime is added, and usually, after flowing thru about one-half of the mixing conduit, sulphate of iron is added. After leaving the mixing conduit the water flows into the first two of a series of nine basins, in which is deposited the greater portion of the suspended matter. It is then drawn off into the secondary coagulating basins, where aluminum sulphate is added, and passes directly on the filters. A second dose of aluminum sulphate is sometimes added in the conduit leading to the filters. The filter effluent is collected in a clear water conduit, terminating in a chamber where liquid chlorine is added, when it flows by gravity to the high-service pumps.

Grading the Sand

The sand obtained for the filters did not strictly comply with the specifications, but a better grade was expected to be obtained by washing and scraping off the fine material which would be left on top, and additional sand was placed in the beds for this purpose. This grading was carried on for several weeks after the plant was started, until it developed that further washing and scraping the fine material from the top was unnecessary, as the finer material gave a better effluent in a shorter time, but required more washings, also that the grains of sand would become coated with calcium carbonate, etc., would increase materially in size and lose specific gravity. This would cause some sand to be lost in washing. The water in filtering passes downward thru the 30 in. of sand and 12 in. of gravel and the strainer plates into an underdrain system of cast iron pipes connected to an effluent conduit, with a total loss of head of about 13 ft. The additional information given with reference to experiences in operating this big filter plant is taken from a paper by C. M. Daily, engineer in charge of the supply and purifying section of the St. Louis Water Department, before the Engineers' Club of St. Louis.

Rate Controllers

Small, flexible, cotton-covered bronze wire from the floats to the drums of the controllers were found too stiff and were replaced by No. 16 bass cord. The small pilot tubes would stick and caused considerable trouble at first, but they were finally replaced, by the contractor furnishing them, with smaller ones made of Monel metal, which has worked very satisfactorily. In commencing operation of the plant each controller was adjusted and the filter unit put in service. The time required to put the entire plant in operation was about thirty days. The adjustment and testing of the nine Venturi meters for the raw water, wash water and chemical solution, the orifice for measuring the chemical solution, the recording pressure and elevation gages received attention in the order given. In the meantime the operating force was instructed to wash at a low rate (18 in. vertical rise per minute), and to start the washing very slowly until all the air was expelled from the bed.

Investigating Operating Features

When all the machinery was in working condition, experiments were conducted as rapidly as possible to determine the best method to follow in operating the filters.

Tests for color and turbidity and determinations of the bacterial content of the water were regularly conducted under the direction of the chemist, with the expectation that the results of these tests could be used daily for regulating the plant operation. It was soon evident that the time necessary for the incubation of bacteria brought these results too late to be of direct service, so that modification of the treatment had to depend upon the turbidity and color tests, leaving the bacterial results to follow later.

The following uncertain features in the operation were investigated without any preconceived ideas as to the final results: When a filter should be washed; the amount it should be drawn down before washing; the rate of commencing wash and final rate; the quantity of water to be used; the method of treating the filter bed after washing; the quantity of water that should be wasted after each wash; the rate the filter should be run and the time before raising the rate and the best rate of filtration.

Turbidity Tests

Turbidity tests of the effluent water were taken every ten minutes from the time a filter was put in operation until the rate of filtration fell off, due to clogging of the sand. On several filters operating at different rates the results were erratic in regard to the amount of turbidity. Filters having coarse sand allowed more turbid water to pass than ones having a layer of fine sand on top, the effective size being a poor indicator of the probable results. These results raised the question of at how low a rate a filter should be run to produce the minimum quantity of turbid water and how long it should operate at this rate. Tests were made to clear up these points. The tests showed that a quantity of aluminum sulphate required to produce a heavy floc, about 14 lbs., and filtering at the one-half-million-gallon rate for 40 to 50 minutes, gave the best results, reducing the amount of turbidity often to one-quarter part per million and never exceeding two parts. No advantage was obtained by leaving the bed standing for any length of time after filling.

Filter Washing

At first when a filter needed washing the influent was shut off and the bed allowed to operate until the water fell below the top of the wash water gutter, when the washing was started and the quantity of water above the sand was wasted with the wash water. Numerous tests were made by allowing the filter to run after the influent water was shut off until the bed was drained. The results were uniform, showing a good effluent until the water level was far below the top of the sand, but the imprisoned air in the sand usually broke the film, cracks appearing along the walls and a contraction of the film seemed to cause checks as the water reached a point a few inches above the sand. Undoubtedly a poor effluent would be produced by the water passing through the broken film, but all the water in the underdrain system and gravel must pass before this water could reach the effluent flume, so there was no danger in drawing the water down to within an inch or two of the sand. If the water is drawn below the sand packing occurs and the bed does not break up properly when washing, hence nothing is gained by drawing the water below the film of sand.

The amount of filtrate necessary to be wasted after washing was studied and conclusions reached that it was unnecessary to waste any water with the adopted method of low-rate filtration for one hour and treating each bed after washing. As to the amount of wash water required and the best rate of washing, some uncertainties still exist, and probably will continue to do so, as the kind of material carried in suspension, the time between washings and the quantity of aluminum hydroxide on the sand greatly influences the quantity of

wash water necessary at any rate of washing. At first a low rate of wash was used, about 18 in. vertical rise per minute; this was continued for about six months, resulting in the formation of mud balls varying in size from ⅛ in. in diameter to 1½ in. in diameter, most of them being of the smaller size; the rate was then raised to 21 in., and finally 24 in. per minute vertical rise, at which rate some of the smaller particles of sand would rise nearly to the wash water gutters. The high rate seemed to prevent the increase of mud balls, but did not eliminate the ones already formed. Screens having ¼ in. mesh mounted on wooden frames were drawn thru the sand while washing; usually after screening the sand in this manner from five to ten times, most of the mud balls were removed, but unless there was a very even distribution of wash water spots or hard lumps in the sand would occur.

The washing of a filter seems to be largely a matter of judgment, the rate being governed by the height to which the sand grains rise, but this should not be high enough to allow sand to overflow into the gutters. The higher rates seem to produce the best results with a minimum quantity of water.

In beginning a wash, if the rate is high, violent explosive actions occur in the bed, due to imprisoned air, which in same cases tear large holes in the sand, rolling the film of mud together, producing mud balls and leaving portions of the bed unbroken. This condition was avoided by first starting the wash at a very low rate, about 3 in. vertical rise per minute, and continuing until all the air is expelled. This method also avoids destructive ram action on the strainer system.

Device to Determine Rate of Wash

Some difficulty was experienced by the operators at first in judging the rate at which a filter was being washed. Opening the wash water valve, a certain amount did not always give the same quantity each time, due to difference in elevation of the water in the wash water tanks, and also to the frictional resistance in the bed. This led to the installation of a low friction rotary switch, which was operated by the rocker arm of the recording device of the wash water Venturi meter. This switch controlled a current to three electric lights mounted at the south end of the plant, allowing one lamp, a green one, to light when the rate of wash was between 5,000 and 17,000 g.p.m, and a white lamp to light when the rate was between 16,000 and 20,000 g.p.m., and a red lamp to light when the rate was above 20,000 g.p.m. These lamps can be seen from any operating table in the plant and allows the operator to wash any filter with a variation of not over 5 per cent in the rate of wash. This device has proven very satisfactory and no inaccuracies of the Venturi meter have resulted from it.

Operating Costs

The average costs for labor, material and general maintenance for the period between June 1, 1915, and April 1, 1916, was $2.47 per 1,000,000 gals. The corresponding figure for the period from April 1, 1916, to April 1, 1917, was $2.05. This cost does not include the lime and iron used in softening and coagulation, but does include the aluminum sulphate and chlorine.

During the year ending April 1, 1916, 1.84 grains of sulphate of iron and 5.57 grains of lime were used per gallon of water pumped into the basins; during the year ending April 1, 1917, 0.72 grain of sulphate of iron and 5.23 grains of lime per gallon were used, making a total cost of purifying the water before adding the aluminum sulphate at the filter plant, for the year ending April 1, 1916, $4.37, and for the year ending April 1, 1917, $3.54 per 1,000,000 gals.

REFUSE COLLECTION AND DISPOSAL

Effect of the War on Garbage Disposal

Before the war writers on garbage disposal frequently called attention to the fact that the disposal of garbage by the reduction method was as distinctly an American institution as the rich American garbage can itself. This method of garbage disposal presupposes wasteful cooking, if it is to be operated on a financially feasible basis.

Just as European garbage was too lean to make the reduction method advisable, the thrift movement in America is now causing a realignment in the selection of garbage disposal methods. In Chicago the weight of the garbage collected for reduction at the city plant has decreased by 50 per cent in recent months. It is doubtful if the American garbage can will be as rich in fats in future as it has been in the past. All these considerations should prompt engineers to revise their ideas about the relative economic advantages of the various garbage disposal methods available.

The Department of Agriculture of the federal government has recently issued some suggestions on the collection and disposal of garbage in the light of war-time conditions. It is suggested that the city food chemist analyze the city garbage from week to week and publish what he finds as an index of food saving or waste in the community. Where there is no official chemist, local chemists competent to determine percentages of fats, protein, starch and organic matter wasted in garbage can render patriotic service by making such analyses in their localities.

One of the first results from the careful analysis of city garbage should be the passage of more rigid enforcement of garbage-collection ordinances, requiring that no glass, tin, wood, burnt matches, paper, string or inorganic trash be mixed with the vegetable material, meat scraps or bones, which can be used for feed.

This dual collection of garbage and trash is being rigidly enforced by Germany in all cities of 40,000 people. Garbage so collected from a population of 17,000,000 people in Germany, although the German garbage pail always has been leaner than the American one, and is especially light at this period, furnished briquettes rich in protein, which, when fed to dairy cattle, produced 1,500,000 to 2,000,000 quarts of milk daily.

In many American cities, however, garbage is sent to reduction plants, where all the fat and oil it contains is recovered for use in making soap or greases.

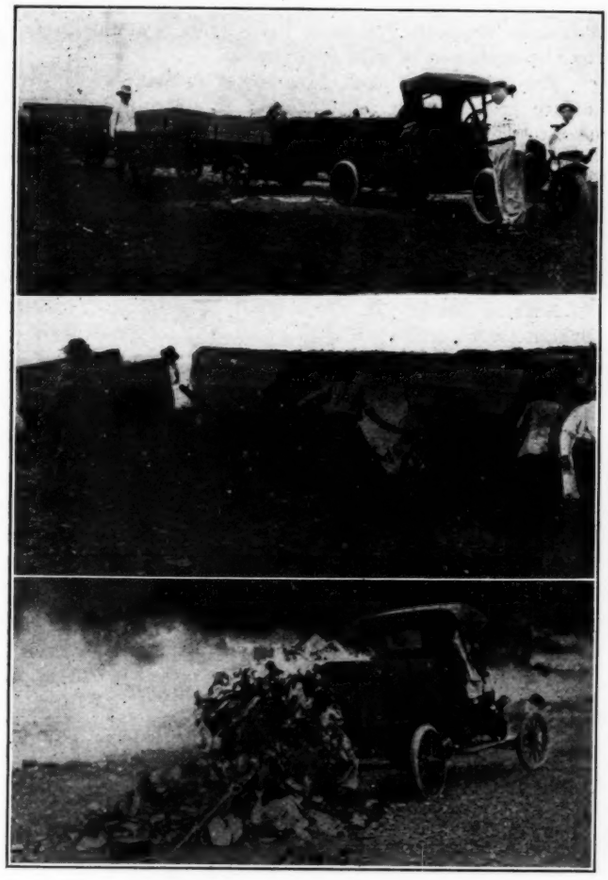
The residue after the oil is extracted is used as fertilizer or dumped into the ocean. This practice has been profitable because the American garbage pail is very rich in fat, American garbage averaging 3 per cent of fat, while German garbage rarely shows even 1 per cent of fat, as the German people never have been wasteful of animal or other fats. Another

reason for the use of the reduction method is that in many cities ordinances prevent the use of garbage for feeding animals, particularly dairy cows, although there is no valid hygienic objection to the use of dried and properly sterilized garbage as food for cattle or hogs.

The department specialists believe that as the thrift idea gains ground less and less fat will be thrown into the garbage pail, and are hopeful that the time is not far distant when the amount of fat will make reduction for the recovery of oils hardly worth while. This will mean that a lot of excellent and valuable foodstuff now being wasted as food will never get into the garbage pail. Even when all fat is eliminated, however, and waste of bread and cereals and meat has been reduced to a minimum, the garbage pail nevertheless will contain in the form of parings, plate scraps and trimmings a vast amount of material which must be disposed of by incineration, burial or feeding to domestic animals.

Motor Haulage Reduces Garbage Collection Cost 50 Percent in San Antonio

The cost of hauling garbage in San Antonio, Tex., was recently reduced 50 per cent by the use of automobile trucks and trailers. This innovation, introduced by Commissioner of Parks and Sanitation Lambert, also doubled the efficiency of the collection service. A thoro trial of the new method of hauling shows that two Ford trucks, each pulling three trailers, and employing four men for eight hours each, do just twice as much work as the same men with ordinary horse-drawn collection wagons in the same length of time.



MOTOR HAULAGE OF GARBAGE AT SAN ANTONIO.

Fig. 1—A Loaded Train. Fig. 2—Dumping the Trailers. Fig. 3—Dumping the Motor by Its Own Power.

The trucks, with their trailers, leave the shop at 8 a. m. with their drivers and two extra men for loading. The extra men, working rapidly, dump house garbage cans into one of the trucks and its trailers as they move along. When one train is loaded the driver takes it to the dump, while the other driver and the two extra men are loading another train. By the time the second train is loaded the first returns empty, ready for loading again. By this scheme the men and machinery are busy all the time. The trucks each have a capacity of 134 cu. ft. and each trailer has a capacity of 74 cu. ft.

The unloading operations have been greatly expedited by an invention of Commissioner Lambert. A cable runs along the bottom of the truck and attaches to a movable steel skeleton dashboard in front of the truck bed. This is snapped to another cable attached to a dead man, and as the truck moves forward the movable dashboard is drawn toward the rear of the truck, pushing the garbage out in front of it. The back of the truck is 8 in. wider than the front. This prevents jamming during the unloading and permits the garbage to spread out without running over the sideboards. The trailers are dumped in ten seconds. Each is balanced on two wheels, and, when unhitched, dumps of itself.

Three views of these garbage hauling units are shown herewith.

Municipal Garbage Piggery Successfully Operated at Hull, Mass.

A drove of 325 hogs is turning garbage into pork and providing cheaper disposal of the waste than was possible under the former garbage reduction methods in vogue in Hull, Mass. Hulls municipal or community piggery has been undertaken in response to appeals for more meat production, and officials of the United States Department of Agriculture and of the Massachusetts Agricultural College report the system as practical.

The towns committee of public safety advanced the money to buy the young pigs, which were taken at cost by citizens. The land for pasturing and housing the hogs was given free, so the only cost was for two large hog houses. One man feeds and manages the entire herd. Each day the uneaten garbage is taken away before any more is fed; all hogs are inoculated against cholera and are kept under sanitary conditions.

When the hogs are ready for market the unit cost of care and feeding will be shared equally by the owners, and this sum, plus the original cost of the pig, will be the only expense to the owners. The public safety committee is holding a surplus of young sows for breeding, since it plans to continue the system. Citizens of this town extol the advantages of its garbage disposal and recommend it for other places of similar size.

Purification of Creamery Refuse

The pumps in our creamery have a capacity of 50 gallons of water a minute. In addition to that, we are making about 100,000 pounds of butter weekly. A part of our buttermilk is condensed for feeding purposes, still a large part is run into the sewer. We would like to build a septic tank of the Imhoff type to make the sanitary condition right for discharge.

L., ———, Ind.,

If a tank of the Imhoff type is to be used, the Pacific Flush Tank Company, 149 Broadway, New York City, should be consulted, as they control the Imhoff tank in this country. As to design of septic tanks or Imhoff tanks, any of the engineers specializing in sewerage and sewage disposal, whose names are found in the Business Directory published in each number of MUNICIPAL ENGINEERING, under the heading Consulting Engineers, will give good service.

FROM WORKERS IN FIELD AND OFFICE

A Federal Waterways Commission

The Editor of MUNICIPAL ENGINEERING:

Sir—

A most attractive feature in connection with recent activities at Washington is the amendment to the River and Harbor Bill, which has passed both houses of Congress, creating a waterways commission to study the entire question and co-operate with all agencies, including municipalities, in the study of the water resources of the country. The amendment follows:

Amendment to Rivers and Harbors Bill, Creating a Waterways Commission

Sec. 19. That a commission, to be known as the *Waterways Commission*, consisting of seven members to be appointed by the President of the United States, at least one of whom shall be chosen from the active or retired list of the Engineer Corps of the Army, at least one of whom shall be an expert hydraulic engineer from civil life, and the remaining five of whom may each be selected either from civil life or the public service, is hereby created and authorized, under such rules and regulations as the President may prescribe, and subject to the approval of the heads of the several executive departments concerned, to bring into co-ordination and co-operation the engineering, scientific and constructive services, bureaus, boards and commissions of the several governmental departments of the United States and commissions created by Congress that relate to the study, development or control of waterways and water resources and subjects related thereto, or to the development and regulation of interstate and foreign commerce, with a view to uniting such services in investigating, with respect to all watersheds in the United States, questions relating to the development, improvement, regulation and control of navigation as a part of interstate and foreign commerce, including therein the related questions of irrigation, drainage, forestry, arid and swamp land reclamation, clarification of streams, regulation of flow, control of floods, utilization of water power, prevention of soil erosion and waste, storage and conservation of water for *agricultural, industrial, municipal and domestic uses*, co-operation of railways and waterways, and promotion of terminal and transfer facilities, to secure the necessary data, and to formulate and report to Congress, as early as practicable, a comprehensive plan or plans for the development of waterways and the water resources of the United States for the purposes of navigation and for every useful purpose, and recommendations for the modification or discontinuance of any project herein or heretofore adopted. Any member appointed from the retired list shall receive the same pay and allowances as he would if on the active list, and no member selected from the public service shall receive additional compensation for services on said commission, and members selected from civil life shall receive compensation of $7,500 per annum.

In all matters done, or to be done, under this section relating to any of the subjects, investigations, or questions to be considered hereunder, and in formulating plans, and in the preparation of a report or reports, as herein provided, consideration shall be given to all matters which are to be undertaken, either independently by the United States or by co-operation between the United States and the several States, political subdivisions thereof, municipalities, communities, corporations and individuals within the jurisdiction, powers and rights of each, respectively, and with a view to assigning to the United States such portion of such development, promotion, regulation and control as may be undertaken by the United States, and to the States, political subdivisions thereof, municipalities, communities, corporations and individuals such portions as belong to their respective jurisdictions, rights and interests.

The commission is authorized to employ, or retain, and fix the compensation for the services of such engineers, transportation experts, experts in water development and utilization and constructors of eminence as it may deem necessary to make such investigations and to carry out the purposes of this section. And in order to defray the expenses made necessary by the provisions of this section there is hereby authorized to be appropriated such sums as Congress may hereafter determine, and the sum of $100,000 is hereby appropriated, available until expended, to be paid out upon warrants drawn on the Secretary of the Treasury by the chairman of said commission.

The commission shall have power to make every expenditure requisite for and incident to its authorized work, and to employ in the District of Columbia and in the field such clerical, legal, engineering, artistic and expert services as it may deem advisable, including the payment of per diem in lieu of subsistence for employes engaged in field work or traveling on official business, rent of offices in the District of Columbia and in the field, and the purchase of books, maps and office equipment.

Nothing herein contained shall be construed to delay, prevent or interfere with the completion of any survey, investigation, project or work herein or heretofore or hereafter adopted or authorized upon or for the improvement of any of the rivers or harbors of the United States or with legislative action upon reports heretofore or hereafter presented.

It is hoped that the President will appoint competent engineers on this commission. They have a great opportunity which if well used will be of inestimable value to the country, but if the members of the commission are not thoroughly awake and competent the results may be disastrous.

F. H. NEWELL.

Cautions for Shovel Runners

The Editor of MUNICIPAL ENGINEERING:

Sir—

Cautions for shovel runners are never out of place. It seems to me that it would be a good idea to have this notice that appeared a short time ago in a steam shovel paper printed or typewritten and pasted up where the shovel runner could not help seeing it. Here are the cautions:

"When moving a shovel back it is important to keep the dipper as close as possible to the bottom of the cut without interfering with the track. Don't have the dipper hanging with steam on the crowding engines. While the machine is standing waiting for a track to be laid the steam naturally gets down in the boiler and the fire will be bad. When you start to move, therefore, a great portion of the power will be

taken from the crowding engines and the dipper will drop, endangering those who are in front of the shovel and tearing up the track.

"Another important thing to remember is not to neglect to chain the circle, in order to keep the boom from swinging. For when the shovel is being moved the back end may get off the track, the shovel may settle on one side or a rail may break, which would be apt to cause the shovel to start to tip over. Nine times out of ten there would be water in the swinging engines as the shovel has probably been standing by while the track was being laid. Hence there would be no power to swing the boom back and balance the machine. As a matter of fact, even tho there were live steam, it would be very difficult to keep from losing control when the boom has swung far over to the side.

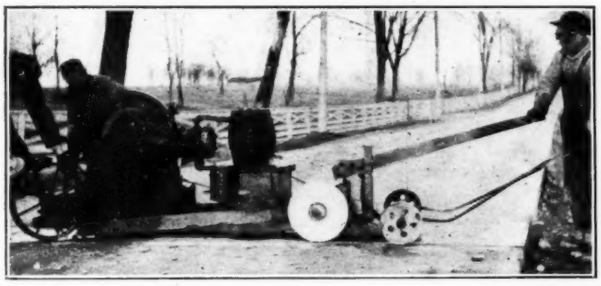
"To prevent absolutely such an accident as this, it only takes a few minutes to fasten one end of the chain over the A-frame and the other end to the turn buckle clevis on the circle. By so doing you will not only save yourself from the possibility of accident, but you will probably save the firm for whom you are working much money and valuable time."

AN OLD SHOVEL OPERATOR.

Device for Grinding Steel Plates in Concrete

The Editor of MUNICIPAL ENGINEERING:

Sir—I send you herewith a picture of the apparatus used on the Dixie Highway in Kenton county for grinding steel plates in concrete road construction. A 6-h.p. gasoline engine is used, having a 24-in. drive wheel, belted to a 4-in. pulley, carrying a 15-in. by 3-in. emery wheel. The outfit is mounted on a four-wheel frame, which is underslung from the rear axle. The center of gravity of the outfit is low and can be guided easily by a tongue attached to the front. By means



STEEL PLATE GRINDER FOR ROAD WORK.

of a lever the emery wheel can be forced down against the plate, very little pressure being required for heavy grinding. Water is supplied to the wheel from a keg on the frame. The complete outfit weighs about a thousand pounds and can be handled easily by two men, although sometimes three are used. Where grinding involves concrete as well as steel, the concrete is first cut away with a coldchisel, thus exposing the steel to the emery wheel. Recently on a job twenty-two joints were ground down, with two and sometimes three men working, in six days.

M. D. Ross, Newport, Ky.,
Division Engineer, Department of Public Roads.

Trucks Operate on Distillate

The Editor of MUNICIPAL ENGINEERING:

Sir—Of the sixty-six automobiles owned by the municipal light department of the city of Los Angeles, Cal., twenty-eight are trucks ranging from one to four tons capacity. They consist of Morelands, Autocars, Republics and Vims. The trucks are operated exclusively on distillate, a 500-gallon tank being sunk in the yard for distillate, while a 500-gallon tank for gasoline to operate the passenger cars is also sunk in the ground near the garage. It is found that distillate is entirely satisfactory. This fuel at 9 cents per gallon has been tested and found to give as good service as gasoline at 19 cents per gallon, thus making a saving of about half.

The department is now experimenting with distillate for the use of the passenger cars. The trucks are used to haul material and supplies from the warehouse over the system for a distance of 60 miles from Los Angeles. Material for the rest of the line is hauled from the other end of the system. Every morning seven or eight heavy trucks leave the central warehouse loaded with supplies and material, while a number of trucks are fitted up with linemen's supplies, etc.

Fords for "Trouble Shooters."

The passenger cars are mostly Fords and are used for the heads of departments, solicitors, trouble shooters, etc. The trouble shooters follow the transmission line as far as they can on cars, then they walk or use mules where cars cannot go. A gang of trouble shooters is maintained at Los Angeles and one at the San Fernando switching station, who patrol a definite stretch of the line every day looking for trouble along the line. There are two transmission lines, one on each side of the transmission towers, and when there is trouble on one line, power can be switched to the other line. This switching station is used in switching power from one line to another in such cases. It is also used for tests of line trouble. In case there is trouble that cannot be located, the transmission line can be tested both ways. There were approximately 285 miles of transmission wire used. This was all contracted for long before the war, so a great saving was made, as the wire at present is much higher than at the time it was contracted for.

Equipped with Movable Shelving.

There is also a complete carpenter shop and saw mill on the grounds which do all woodwork. The general warehouse and offices are housed in a two-story building, 80x120 feet, which was built in 1916. All supplies and equipment for the system are stored here. A spur railroad track enters the building. This building is equipped with an efficient pneumatic elevator. Here are stored transformer oil, transmission and guy wire. There are 3,600 bales of copper wire for the distributing system. There are also transformers for distribution, ranging from 3 to 50 k.w.; street lighting fixtures, incandescent lamps, meters, bolts and miscellaneous hardware. The bolts and miscellaneous hardware are stored in bulkheads. There is no shelving built into the warehouse, all are movable units so they can be adjusted to any purpose. On the second floor in this building there has been fitted up a room for laboratory purposes and for testing meters and transformers. A special rack built of angle iron is used for storing meters. One and one-half-inch pipes are set up for supports at a distance of every 8 feet; 2½x2½-inch angle iron 8 feet long is attached to the end of the upright pipe by means of U-bolts. Special clamps made to fit over the edge of the angle iron are used for hanging the meters on. There are twelve angle irons to each unit; each unit is capable of holding 320 meters.

Materials Purchased by Requisition.

During the construction of the aqueduct, all purchases of material originated by requisition, which was signed by the division engineer or superintendent and approved by the office engineer or chief storekeeper. When purchased, the goods were shipped direct to the division requiring them, or in case of stock articles were delivered to the Los Angeles warehouse. Engineers desiring shipments from the Los Angeles warehouse made a warehouse requisition, which was approved by the office engineer and chief storekeeper before being filled by the local storekeeper. Shipment was then made to the division, and record made on the department transfer.

The material on each division was carried in a division warehouse. When the foreman on the work required supplies,

he requisitioned them, in duplicate, noting the work order to be charged.

On the first of each year an inventory was made of all material on hand in the different warehouses. These were matched against the ledger balances shown in the accounting department against the several divisions.

Charles W. Geiger, Los Angeles, Cal.

A Refuse Collection Wagon in Successful Use in Dallas, Tex.

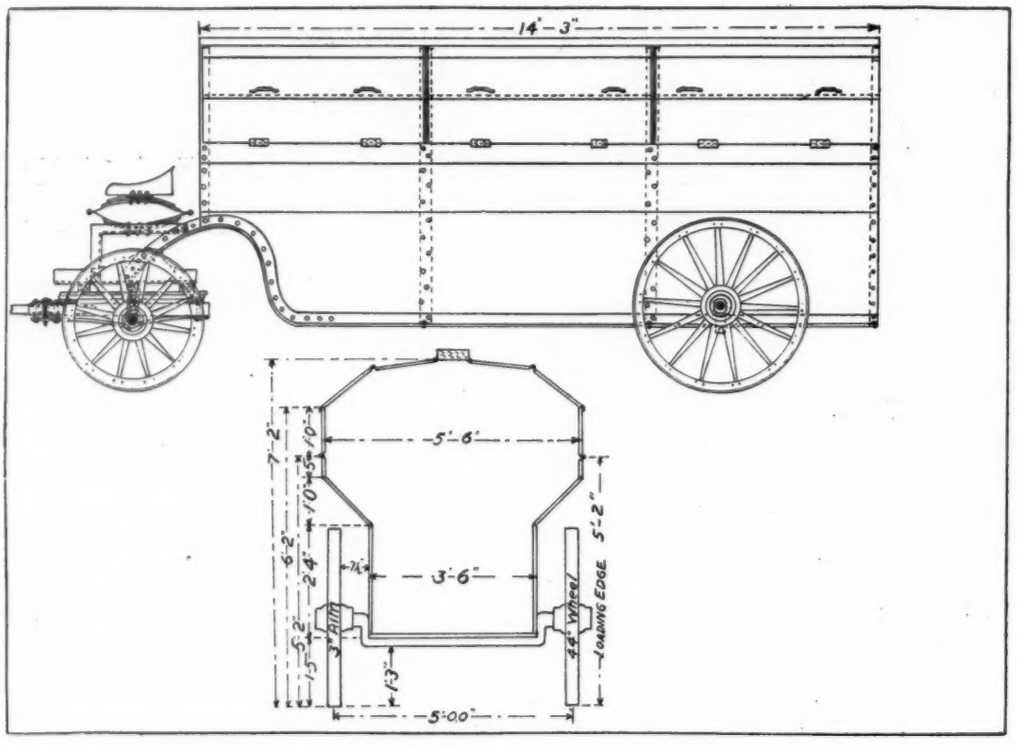
To the Editor of Municipal Engineering:

Sir—Herewith please find drawing of improved refuse collection wagon designed for use in Dallas, Tex.

As the bulk of our refuse in Dallas is made up of trash with few ashes, and with a small percentage of garbage, our problem was one of finding a wagon of such capacity that the driver could spend more time on his collection route than heretofore. Each driver makes two trips per day, and often has collected and dumped his load even after a long haul by 11 a. m., and on his second trip by 4 p. m. The lost hours could have been put in collecting refuse if he had had sufficient wagon capacity. This improved wagon has a 50 per cent. greater capacity than the wagons now in general use.

The wagon is underslung so as to bring the loading edge near the ground, and in most instances where the wagon is drawn up to the curb the loading edge is less than 5 feet high. The wagon is designed to unload at the rear. It has tight wooden covers built in three sections, as shown, which rest on T-bars. Because of dead alleys and narrow streets the cut-under front-wheel feature is added to facilitate turning.

A wagon body having closed covers as shown, but for use on ordinary running gear, has been built and put in service in Dallas, and is giving satisfaction. The loading edge, however, on the wagon already built is somewhat higher than on the one shown on the accompanying drawing.



SKETCH OF IMPROVED REFUSE WAGON USED BY DALLAS, TEX.

The new type of wagon has the additional advantage that it can be converted into a bottom-dump wagon at any time, for use in connection with dumping platform for a modern incinerator.

The wagon is designed for standard wheel gage so it can be used in muddy weather, but for use in paved sections of the town the wagon width of 5 ft. 6 in. might be maintained instead of being reduced to 3 ft. 6 in.

H. W. Van Hovenberg,
Dept. of Public Health, Dallas, Tex.

Pavement in Franchise War

To the Editor of Municipal Engineering:

Sir—As the result of a recent Ohio franchise dispute, the citizens of Stark county put complete reliance on motor haulage to banish fear of arbitrary traction measures. The following data were supplied by L. A. Leonard, county commissioner of Stark county, and are of special interest. Mr. Leonard says that when an intercity highway attracts a traffic of several hundred vehicles per hour—when it knits the interests of two neighboring communities and leads to a suburban residence development beyond all anticipation—it would seem that the road in question had amply proved its value.

In the case of the Canton-Massillon highway, in Stark county, Ohio, the public has another reason for pride and esteem in a public thorofare. This road (and the fact that it is improved so splendidly with brick) constituted the big card in the hands of the public during a long controversy with the Northern Ohio Traction and Light Company, which owns an interurban railroad connecting the two cities. The merits of the controversy are up to the Supreme Court of the United States, and either party may be in the right so far as the subject matter is concerned.

County Commissioner Leonard points out that one of the cards which a traction company holds is its ability to discon-

tinue service, to lessen its convenience or to increase the fare, thus disrupting the daily life of those who depend upon it and forcing a speedy compromise on the part of the public. In the present case no such threats have had any efficacy for the simple reason that the motor-bus service between the two cities over the Canton-Massillon highway is substantially as good and 5 cents cheaper than that afforded by the electric railway. The owners of a rapidly increasing number of private autos are also rendered independent of railway service, and there is nothing for the company to do, even if it desired otherwise, but to wait for the proper tribunals to give their decisions on the various points at issue.

It is stated that during the December blizzard of last year traction service was completely at a standstill for two days, not merely between the two cities, but on the city lines of Canton as well. Nevertheless, the motor busses plowed thru the snowdrifts and scarcely one of the hundreds of interurban wayfarers missed an appointment as a result of the traction tie-up. The highway in question is eight miles in length and a part of the Lincoln Highway route. It was improved under a comprehensive plan that included provision for two 18-ft. brick pavements, with the railway tracks in the center of the road. The road was widened uniformly to 66 ft., and in some places, where turns and jogs were straightened, it assumed a width of more than 100 ft. Only the south driveway was paved at first and the consummation of the plan partially defeated by the traction company, which persisted in maintaining its tracks at the northern edge of the road. One of the contentions of the county has been for the removal of the tracks to the center of the road and some financial assistance from the traction company in paving the northern half of the roadway, this payment being a sort of track rental.

Considering the enthusiasm which this admirably paved highway now inspires, it seems strange to recall that there was open hostility to the paving plan when it was first broached. It took a patient and enthusiastic canvass on the part of Charles L. Stoner, then clerk of the county commissioners, to enlist the abutting property owners in the support of the plan. At length 80 per cent. signed up, moved in part by a promise of $75,000 in state aid. Even after construction commenced there was opposition to the straightening and widening of the road by some abutting owners. In one instance the pavement was completed up to a property line and was left there, barricaded by a clay bank, until public sentiment shamed the obdurate owner into withdrawing his opposition. To-day, any one who opposed the idea of an intercity pavement would be examined as to his sanity.

FRANK C. PERKINS.

Why Cities Should Continue Making Public Improvements in War Time

Should cities continue making public improvements or "sit tight" until the war is over, before going on with the construction of public works? Three correspondents have written the editor on this subject and their views follow:

The Editor of MUNICIPAL ENGINEERING:

Sir—

There are many reasons why cities should continue making public improvements without waiting to see how the war turns out. Roads, bridges and other public improvements are going to be needed during and after the war as much as ever, and we can see no reason why their construction should be discontinued.

There is a large amount of capital invested in plants and equipment for the handling of this character of work, and this capital should be kept busy the same as in any other line of business endeavor. Not all of us are going to be permitted to go into the trenches, and with the heavy drain of the war it is going to be necessary to speed business up to its highest notch in order to enable those who remain at home to do their bit and help to pay the bills.

In addition to this feature, the labor which is usually employed in this character of work is not of great value in any other line on account of their having confined their efforts to this character of employment. Hence, if these public improvements should stop, these men would be out of a job and would be compelled to turn their attention to something else, where they would not be as efficient or of as much assistance in making business go strong as they are in the handling of public improvements.

Therefore, it occurs to me it is evident that this line of business should not be in any way neglected, but should be speeded up as much as possible.

Yours very truly,

THE HACKEDORN CONTRACTING COMPANY,
By HILLIS F. HACKEDORN, President.

Indianapolis, Ind.

The Editor of MUNICIPAL ENGINEERING:

Sir—

It is as inconceivable to a normal mind for public improvements to be stopped or hindered now, at this crisis, as it would appear preposterous to break down important bodily safeguards to health when a deadly disease is making attack upon the human system.

We need, doubly need, every advantage which the improvements themselves can confer. We need the activities which they engender in trades and business, and we needs must have, in a superlative degree, cool, calm judgment, a never-failing by-product of straight, strong, concentrated attention to legitimate business, of which few branches equal or excel constructive public improvements.

Many problems hard of solution confront us, but this is easy, for if infinity equals our productive and constructive power in time of peace, surely it must be raised to the nth power of efficiency to cope adequately with conditions which now assail us and which will be even more formidable to combat when our armies are disbanded. When the soldiers come back from victory, with no longer need for the high-tension strings of patriotism, what other force in the world can restimulate their relaxed energies like seeing and being brought into line with organized, steady labor which has never been discontinued or demoralized?

"Labor is life; 'tis the still water faileth." This is the best motto for all of our workers, our whole people, our country.

Respectfully yours,

FRANK M. DUVALL.

Annapolis, Md.

The Editor of MUNICIPAL ENGINEERING:

Sir—

I feel that all questions of patriotism or duty should be left entirely to the individual man, and that the best argument to be advanced for uninterrupted construction programs from the standpoint of purely economic logic is this: the improvements must be made. If we do not make them now, we shall have to do it later, because the expansion and the development of our municipalities demand them. Of course, it will be granted that the expense of the war's burden upon us will continue many years after the close of hostilities. From this we may well reason that we will then be in no better financial condition to make these necessary improvements than we are at the present time. Therefore, let us do it now while we are sure that we can bear the burden; and having done this, let us begin to reap the benefits at once.

Yours truly,

24 S. Seventh St., Philadelphia, Pa. R. L. KETCHAM.

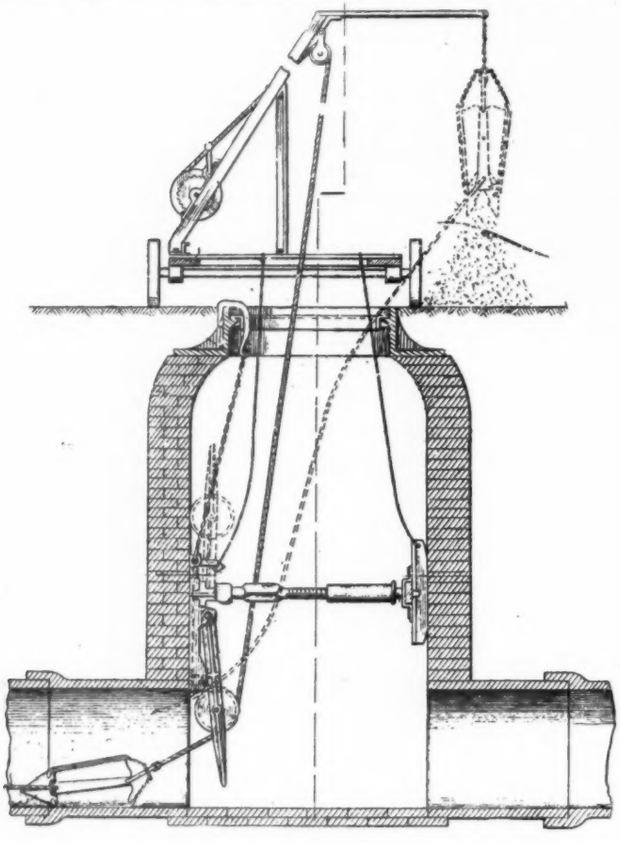
PLANT UNITS AND LAY OUTS

Improved Sewer Cleaning Machine

The problem of sewer cleaning has been simplified to a considerable degree by the Kuhlman mechanical cleaner recently developed. In this machine the pull of the cable closes the jaws automatically, making a smooth job of cleaning.

Five buckets are provided for in the system, so that any sewer from 8 in. up may be cleaned. Roots and deposits of sand, etc., have been removed with the bucket rig.

Considerable advantage is claimed on account of the fact that the bucket need not be drawn from one manhole to another, but is only pulled into the sewer far enough to be filled with the deposit, at which point it is drawn back out of the same manhole in which it was inserted, since the bucket is so constructed that when the reverse pull is made, the jaws close tight and hold anything that may have entered the



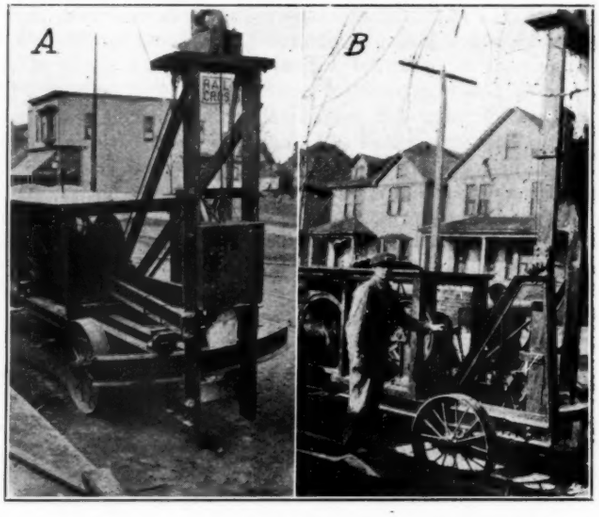
A REVERSIBLE SEWER CLEANING MACHINE.

bucket in its forward movement. Considerable time is saved when the deposit is near the manhole by reversing the pull to the shortest distance to the manhole. The trolley jack is so arranged that the buckets will slide up out of the sewer without the cable cutting into the sewer or the brick work.

For the operation of this system of sewer cleaning there are two steel trucks used, with hoist windlass and swinging loading boom; also two trolley jacks for guiding the cable and buckets in manhole. Two ⅜-in. wire cables 300 ft. long are utilized, with a 6-in., 8-in., 12-in. and 15-in. expansion bucket and a 10-ft. hand hook.

Concrete Breakers for Trench in Pavement

Two types of concrete breakers, for tearing up paving preparatory to excavating trenches of water, sewer and other pipe lines and conduits, are here illustrated. Both of these machines were designed and built by Raymond A. Mercier, superintendent for J. A. Mercier, general contractor, 216 Hammond building, Detroit, Mich. The information here given was furnished by J. H. McGinn, of this contracting organization.



MACHINES FOR BREAKING CONCRETE OVER TRENCHES.

Machine A is equipped with swinging leads and can be turned to break up a strip 6 ft. wide. The leads are 6-in. channels, 8 ft. 4 in. long, spaced 16 in. apart. The lower braces to leads are also 6-in. channels, with straps on one side for inserting the pole to guide the location of hammer blows. The upper braces are 4-in. channels. The hammer weighs 600 lbs. and measures 17x22x12 in., with ½-in. groove on either side to fit the leads. The swinging arc is an 8-in. I-beam of 6-ft. chord. The main body frame is of four 8-in. I-beams, 15 ft. long. The power is furnished by a 9-h.p. horizontal, water-cooled Foos gas engine, connected with flexible link chain drive to the countershaft. The countershaft is geared to an ordinary hoist clutch, which is equipped with a foot brake. A ½-in. cable from the clutch runs down under one 15-in. sheave wheel and over a second 15-in. sheave mounted on the pivoted end of the swinging leads. The third 15-in. sheave is at the head of the leads. The running gear consists of 36-in. iron wheels at the hammer end and 24-in. wheels at the engine end. An ordinary wagon tongue and eveners are provided for drawing the machine by horses from job to job. When in operation along the line of the trench, the machine is advanced by attaching a cable to the wagon tongue, passing it thru a pulley block fastened to an iron stake driven in the pavement some distance ahead of the machine, and back to an ordinary hand-operated windlass.

The wearing surface of the pavement is removed by hand before the breaking up of the concrete base is begun with the machine. The hammer has a removable wedge shape point, which is fitted with a two-way bolt hole, so the wedge edge

can be made either transverse or longitudinal to the line of the trench. Thus it can be used for cutting sheet asphalt to an accurate line.

Machine B is the same as machine A except for the leads. Machine B has stationary leads of 6-in., oak-lined, channel iron. They are 12 ft. long and are spaced 18 in. apart. The leads are supported on the main body frame by an A-frame, at either side, made of two 3-in. angles, back to back. The leads are pivoted on top of this A-frame so as to permit the leads to fold back and rest on top of the machine housing, when the machine is being moved from one job to another.

"Standardized" Meter Top

In a meter-box top which was recently placed on the market the ordinary round throat is replaced by one rectangular in section. This feature is said to greatly lower the cost of installation, as the bricks can be laid close up to the casting with a minimum of breaking and fitting.

STANDARDIZED METER TOP.

The new "Standardized" top is made especially for tile measuring 18 in. inside diameter. It is furnished either with or without an inner lid. Light weight is one of its notable features, a reinforcing rim extending around the edge of the casting, giving it added strength, while allowing the weight of the metal to be kept down.

A locking device is used which it is claimed eliminates any possibility of the cover being lost or stolen. A turn of the unlocking wrench releases the catch and also raises the cover a good half inch above its locked position. This effectively disposes of the frozen-cover question, without any necessity of chilled hands or battered fingers. As the locking device itself is a bronze casting, there is no possibility of corrosion.

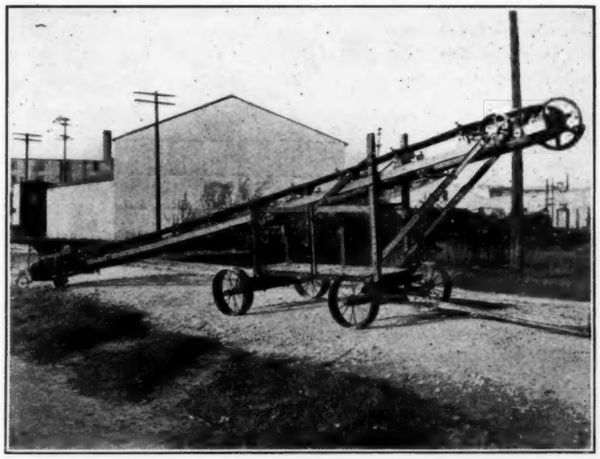
Portable Loading and Conveying Machine

That adherence to the old "horse and wagon" method of doing work involves considerable loss is once more proven, this time by a portable loader. It is claimed that the loader (which is operated by a 4-h.p. engine) does work equal to ten or more horses, depending on the character of the work. This economy is the direct result of the most efficient application of power.

The "E & S" portable loading and conveying machine is used for doing all kinds of excavating, and loading such materials as sand, gravel, crushed stone, coal, ore and dirt of all kinds. As illustrated, the rig is essentially a belt conveyor mounted on a truck in such a manner that the lift is easily adjustable. Load is put on the belt thru a hopper at the lower end, power being supplied thru a reduction gear to the pulley at the upper end of the conveyor. The engine is set directly on the truck platform.

In excavation work with the "E & S" there is a marked advantage, due to the fact that the machine itself is on the level, while the lower end of the conveyor extends into the basement and is automatically lowered as the excavation goes on. This feature makes it possible to load on the street level or at any required depth below the level of the street, in this way eliminating hauling loaded wagons up steep inclines or out of excavations, thus saving time, men, labor and horses, which, in all, is saving money.

This machine can be used to great advantage in the loading from stock piles of sand, gravel, crushed stone or coal to



PORTABLE LOADING AND CONVEYING MACHINE

wagons or flat cars. The machine is built almost entirely of steel, reinforced with wood. A special feature of the "E & S" conveyor is its dust-proof roller bearings, over which the belt moves. These are adjustable to any width of belt, and have a much longer life than the lower-priced cast-iron rollers.

A Pipe Line Street Flusher

Somewhat at variance with the ordinary idea of a portable water tank propelled by horses or gasoline, is the portable pipe line which has been developed by the Buffalo Municipal Equipment Company for use in flushing streets. While the pipe-line flusher is less rapid than the tank flusher, it is said to be more thoro, and will, it is claimed, entirely free the street of dirt. Pivot-mounted discharge nozzles are so fixed that they can be turned in a complete circle, flushing the street surface from curb to curb.

As the stream from any nozzle cleans well ahead of the next nozzle in line, the operator can work from one to the next, cleaning up thoroly as he goes along, and always working down hill if on a grade. At the last section of pipe in the line two swivel joints and nozzles are provided so that the operator can clean up a space at least equal to another section of pipe. For a 240-ft. stretch of pavement the cleaning time

PORTABLE PIPE LINE FLUSHING OUTFIT.

with the portable flusher is given as from 5 to 7 minutes.

It is claimed that the valve arrangement is very economical of water, as the operator has direct control of the stream at all times and shuts off the flow instantly with his wrench when desired. As the nozzles are set very low, the stream does not damage the pavement. This feature prevents washing away of sand and gravel during the flushing process.

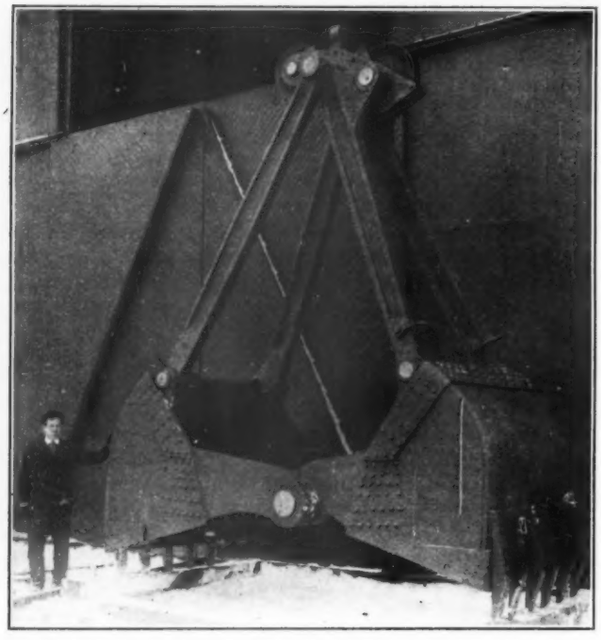
As shown in the accompanying illustration, all movements

of the nozzle are controlled by the operator with a long-handled wrench, which is the only equipment he needs to carry. The entire pipe line, being mounted on small wheels, can be moved as desired without disconnecting, and as all connections are flexible, can be taken around street corners and past obstacles. For long hauls the units are simply disconnected and loaded like ordinary pipe on a wagon or motor truck. Claim is made that the use of this apparatus has resulted in a considerable decrease in the cost of flushing city streets.

A Big Clam Shell Bucket

The Williams clam shell bucket here shown has a capacity of 10 yds., and weighs approximately 25,000 lbs. A forged steel hinge pin 9 in. in diameter holds the jaws together. Corner pins and sheave pins are each 6 in. in diameter. The high carbon lips are 1½ in. thick and the scoop plates 1¼ in. thick.

While no data are available as to the capacity of this giant



10-YARD CLAM SHELL BUCKET.

bucket in actual service, an estimate can be formed from figures showing work done by a 5-yd. bucket of the same design. On a levee project at Beardstown, Ill., a bucket of this size dug 167,000 yds. of clay in a month, and in eighteen working days handled 157,000 yds. of clay. Work was done by the Edw. Gillen Dock, Dredge and Construction Company.

The cables used to operate the 5-yd. bucket were 1½ in. for the hold line, which is equipped with a burden block, the main weight being lifted with two parts of line. The closing line was 1½ in. on the straight lift, the drums being so arranged that one operated at twice the rope speed of the other.

An All-Year Truck Cab for the Contractor

As much often depends on the motor truck driver as on the truck itself, and the driver's comfort exerts a marked influence on his efficiency. For this reason contractors operating motor trucks will be interested in a new feature for Kissel trucks. It is a new adaptation of Kissel's original convertible idea, giving a closed cab for winter, which is easily changed to the Kissel standard open cab for summer use.

The cab is a little over 5 ft. high over all, and is substantially constructed of bolted hardwood frames covered with treated sheet metal. The dash is of heavy plated metal. The cab is sufficiently flexible to negotiate rough roads successfully. The seat accommodates three men, and the tank and tool compartments are under it. All the accessories are there in unsurpassed arrangement and completeness. Special Pittsburgh glass is furnished for the doors, sides and rear window, which has a heavy wire screen. There is a rain-vision windshield with the winter equipment.

This all-year cab is wind-proof, rain-proof, cold-proof—in a word, it is weather-proof the year round in any climate.

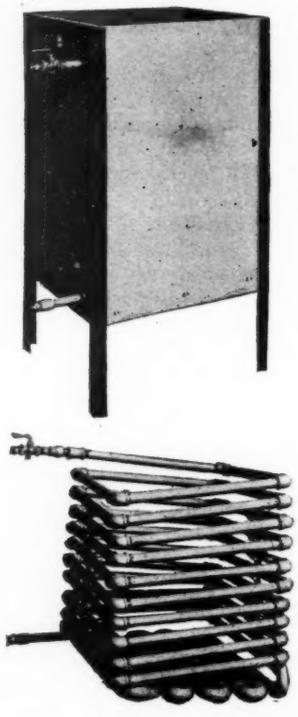
Portable Water Heater for Contractor

Herewith is illustrated a new portable water heater, which should be of particular interest to contractors. The outfit consists simply of a coil 100 ft. long of 1-in. water pipe, enclosed with a sheet metal salamander.

A fire built inside the salamander heats the water as it passes thru the coil, thus providing a steady stream of hot water. The value of this as an adjunct to cold weather concrete work is obvious.

Practically any burnable material can be used as fuel. The machine is open at the bottom, where the lower coil forms a grate for the burning material. The coil itself is held in place by two bars with lugs, which project between the pipes on opposite sides of the coil.

The machine weighs only about 300 lbs. and is easily portable. C. A. Londelius & Sons Co., Chicago, are marketing it.



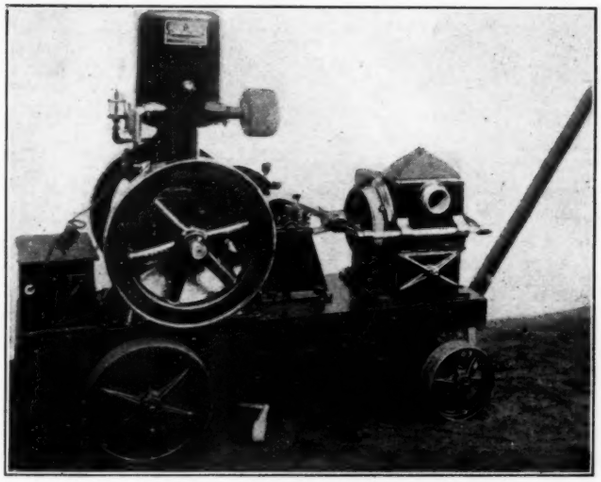
Among the well-known Chicago contractors now using the heater are Stressenreuter Brothers, 3020 South Halstead street, and the Please Concrete Construction Co., 805 Stock Exchange Building.

A Portable Gas Engine Pump

Reliability and portability are combined in the gas-engine-driven diaphragm pump shown in the accompanying illustration. This Novo Engine Company set consists of a vertical 4-cycle gas engine connected thru gearing and an eccentric to a double-acting diaphragm pump. As the diaphragms are

placed in vertical planes it is claimed that they are not so likely to be cut by the dirty, gritty water handled.

Being power-driven and working near capacity all the time, the pump has considerably more than twice the capacity of a single-acting hand-operated pump of the same size. Cost of operation is low, as the engine will operate continuously, it is claimed, on less than a quart of fuel per hour, handling in this time from 6,000 to 8,000 gal. of water.



PORTABLE GAS PUMPING UNIT.

As this pump has no plunger, and as a rubber diaphragm takes the place of a piston, there is nothing to be cut by sand or grit. A considerable saving is made on account of the fact that no attendant is necessary for the set. The pump can be started by any one who can give the wheel a good strong turn. The flapper valve can be replaced by the laborer in charge of the outfit.

The engine used is of the hopper-cooled type, the cooling water being poured in an open jacket surrounding the cylinder. Due to special design, it is said that the hopper and cylinder will resist coldest weather, both being guaranteed by the makers against cracking, even when the cooling water freezes solid.

Make-Up and Cost of Home-Made Portable Pump

An efficient portable centrifugal pump outfit designed to pump out flooded manholes was constructed a short time ago by the Lincoln Park commissioners, Chicago, under the direction of C. H. Shepard, electrical engineer. The pumping plant consists mainly of a 12-h.p., 1,500-r.p.m. gas engine (marine type), direct connected to a 500-gal.-per-minute centrifugal pump. These are mounted on an ordinary four-wheeled hand truck, together with radiator, gas tank and circulating system. For cooling, an ordinary automobile radiator is used.

With this improvised set a volume of 300 gal. per minute can be pumped against a 15-ft. total head.

All of the control apparatus is grouped together at one end of the machine, so that it can easily be reached by one man. Free access is obtained to all parts by a system of hinged removable walls.

These detailed figures given by Mr. Shepard show the actual cost of building this unit:

Cost of Building Emergency Pump Unit

MATERIAL

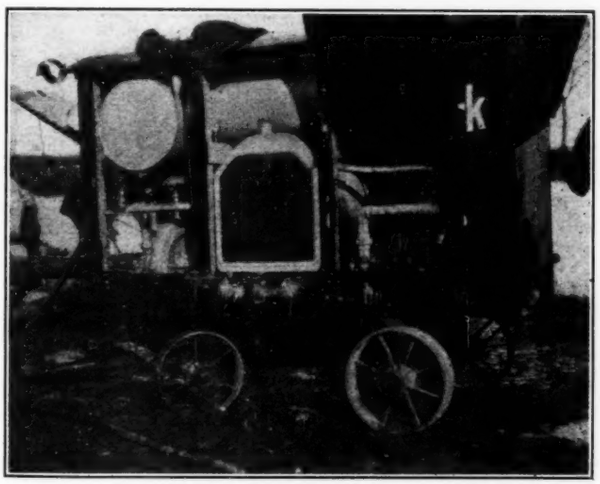
1 marine engine and muffler	$ 90.00
1 radiator	25.00
To build truck for engine pump and wheels	225.30
To install engine on pump truck	69.07
Painting pump truck	21.54
To supplying suction hose, valve and fittings	125.89
3 1¼-ft. valves	2.82
1 cap	.10
12 bolts, various sizes	.12
5 pipe plugs, various sizes	.36
5 bushings, various sizes	.45
12-ft. water pipe, various sizes	2.34
28 nipples, various sizes	2.24
4 tees, various sizes	.30
6 unions, various sizes	.99
56 screws and nuts, various sizes	1.00
19 ells, various sizes	1.61
6 padlocks, various sizes	6.60
Miscellaneous material	24.13
Total	$599.86

LABOR

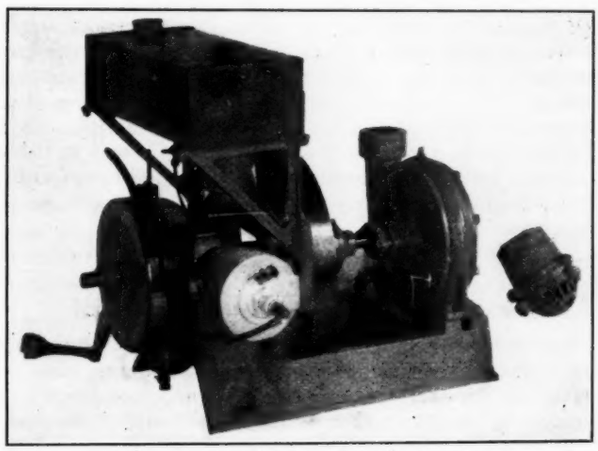
Mechanic, 31 hours at 50c	$ 15.50
Helper, 104 hours at 32c	33.28
Total	$ 48.78
Garage expense (overhead)	120.85
Grand total	$769.49

A Compact Pumping Unit

The gas-engine-driven centrifugal pump here illustrated is a convenient piece of machinery for the contractor, both on account of its light weight, which permits easy moving, and



A HOME ASSEMBLED PORTABLE PUMP.



CONTRACTOR'S SMALL PUMPING UNIT.

because it is really a "general purpose" set. As will be noted from the illustration, the engine is of the 2-cylinder type, with cylinders directly opposed. Use of air instead of water for cooling purposes gets around any danger of frost-cracked cylinder, that exists with the water-cooled engine.

When the pump of the set is not required, the removal of three screws disconnects the engine, leaving it free for another work. In the construction of the engine there are no cams or lubricating valves to get out of order, and the lubricating oil is put into the tank with the fuel oil.

The limit for lifting water with a centrifugal pump is about 25 ft., but the height to which it will force it is from 60 to 100 ft. The 3-h.p. unit delivers 125 gal. per minute at 30-ft. head, and the 5-h.p. unit delivers 250 gal. per minute at 30-ft. head. The 3-h.p. pump has a 2-in. suction and 2-in. discharge, with a weight of 160 lbs., while the 5-h.p. pump has a 3-in. suction and 2½-in. discharge, the weight being 250 lbs.

New End Dump Trailer

A new end dump trailer, for which claim of high efficiency is made, has been perfected and is finding a growing field in the haulage of construction materials. The end dump mechanically operated hoist and body, as illustrated, is known as the "Archer," and in the size shown is mounted on a 5-ton Troy

AN END DUMP HOIST AND BODY.

trailer. A novel feature of the hoist is the fact that one man can easily raise the body with its 5 tons of contents to an angle of 45 deg. in 2 minutes' time. Sand, stone, cement and other construction materials are thus handled easily. Owners of motor trucks and trailers claim that 75 per cent to 100 per cent more material can be hauled with a trailer thus fitted for quick dumping, with only a slight increase in cost of operation of truck.

Industrial Truck for Hauling Material

One ordinarily thinks of 3-yd. dump wagons or big 5-ton motor trucks when the subject of hauling bulky, loose materials is considered. However, the attached illustration shows a rig recently placed on the market, which, because of its extremely small size and simplicity and speed of operation, has made a place for itself with a number of up-to-date contractors.

The motive unit is an electric-driven industrial truck of 2-ton capacity, similar to those commonly used in warehouses and railroad stations for hauling trunks, boxes and miscellaneous supplies and heavy materials. Upon this truck is mounted a side-dumping hopper of 1½-yd. capacity. One of

A COMPACT HEAVY-HAULING UNIT.

the features of this patented machine, which differentiates it from the ordinary industrial car, is that the load is thrown out several feet away from the truck, as shown in the illustration.

Over-all dimensions of the complete machine are: Length, 8 ft.; width, 4 ft.; height, 4 ft. Hoppers dumping in a similar manner from the end of the truck are also manufactured.

A Water Ballast Roller

A water ballast roller has been devised by an English manufacturer to provide for rolling roads under varying pressures as required by differing operating conditions. The 12-ton oil tractor illustrated is provided with a 4-cylinder, 35-40-h.p. engine, and has a tank roller of sufficient capacity to increase the total weight to 14 tons.

A WATER BALLAST ROLLER.

The rear roller, as shown in the accompanying illustration, is made up of cast iron and is of heavy reinforced construction, to do its work as a drive wheel. Power is supplied by a moderate speed, water-cooled engine, the radiator being located over the rear roller, where its weight is most useful. Two speeds are provided, viz., one mile and three miles per hour, the speed change being made by control levers located within easy reach of the driver.

SALES ENGINEERING

Opportunities for Engineers in the Selling Field

By N. H. Jacobsen, Sales Engineer, Chicago

The engineering profession presents a very broad field of activity, the extent of which is not properly appreciated by those most vitally interested. The limits are very hard to define, because they are gradually being extended by the discovery, in various lines of effort, that the engineer possesses the best fundamental equipment to secure results in many lines. The development of engineering courses of study to their present high standard in our universities and colleges has been due, very largely, to a demand for specialized training, but as the results of this curriculum in other than highly specialized fields are being more fully understood and appreciated, the study of engineering is coming to be considered a fundamental—the best possible foundation for many kinds of work.

Many Engineers Get Side-tracked

With all its vast opportunities for success to the individual —success based on achievement of the highest order—there is something pitifully tragic about the engineering profession. The average engineer is the victim of the wrong idea. He has seriously and conscientiously set about thoroly to prepare himself, omitting none of the steps necessary to secure proper equipment. His technical training completed, he has attacked the problem of practical engineering with energy and enthusiasm and deserves to succeed.

Round Pegs in Square Holes

You engineers who embarked on your life work ten, fifteen, yes, twenty years ago, look back on the men who graduated with you—men who, with few exceptions, were alert, capable fellows. Some have achieved distinction, a large number have risen and are advancing but too many are standing still or going backward. A few would have failed at anything but most of them would not and should not. They are blindly devoting themselves to engineering as a highly specialized vocation, to engineering in the narrowest sense. Here lies the tragedy that, in spite of what has been said and written about the opportunities for men with engineering training in that broader field of engineering, which overlaps other activities than technical work, men, without the proper temperment continue figuring stresses, designing or superintending construction, long after they have discovered that they are not suited for work of this nature. By virtue of hard work and the good qualities they possess, they may manage to overcome the fault of inaptitude sufficiently to hang on but they are not growing and, in the true sense of the word, they never will until they find the solution in work of a different nature. Their happiness depends upon their finding it. It is the duty of our universities, our societies and our engineering papers, without deprecating in the least the importance of technical work, to preach the gospel of "engineering the proper foundation for achievement in the business world."

Opportunities in Salesmanship for Engineers

Salesmanship is one of the important non-technical fields in which the engineer is making his mark. Here is a dignified calling where the opportunities are practically unlimited. The qualifications are hard to analyze but the transformation of the salesman from the agreeable individual who can talk but is not familiar with what he is discussing to the man in possession of definite, accurate information, is due very largely to the men with engineering training and experience who are taking up this work. They have been taught to persevere, to concentrate on every problem regardless of the difficulties until they arrive at the solution. Sales results are nothing more nor less than the solution of difficult problems. The important methods of attack which apply are the same as those which must be used in the consummation of a strictly technical achievement. There are, of course, questions of personality, of proper understanding of human nature etc., but the environment of the engineer is such that he should possess these qualifications to at least as great a degree as any one. If he does not, this and any other work offers to him the opportunity of success only to the extent that he is able to overcome his personal handicap.

Proper Selling Field for Engineers

Although the engineer need not necessarily restrict his efforts to any one branch of selling, it is only natural that his services are particularly valuable in the sale of materials, equipment etc., in the design or use of which engineering questions are involved. Even assuming that we consider this as defining the limits of the sales engineer's field of work, we will find that we have included a very large percentage of the things which are bought and sold.

And here the engineer is supreme. Ability intelligently to discuss a thing can come only from exact knowledge regarding it. Only the product of merit can survive and the extent to which it is used will depend upon two things i. e. how meritorious it is and how carefully and accurately its good points are explained to the prospective buyer. The accomplishment of the latter is the business of the salesman and the engineer has such a distinct advantage over the type of men who, until recently, have been devoting themselves to this work that he stands head and shoulders above them. Their only chance to reach the top or to stay there is by acquiring for themselves some of the things which the engineer already possesses and that is what the ordinary business man, engaged in the sale of what we may for convenience call "engineering products," has been forced to do in order to keep abreast of the times.

Engineers, Purchasing Agent and Salesman

Organizations which are large buyers find it necessary, in the interest of economy, to have their engineering and purchasing departments work hand in hand. An engineer prescribes what is to be bought and the successful proposal must have his approval before the deal is consummated. If the purchasing agent is a man with engineering training so much the better (and here I may incidentally hint at another field that is open to the engineer), but the important fact which I wish to bring out is that there is an engineer on the other side of the fence and the only man who is thoroughly competent to cope with the situation is the sales engineer. Often there is only one product which exactly meets the requirements and the sale is practically made before it reaches the purchasing agent. Our friend has been "on the job."

Selling Offers the Engineer Economic Salvation

The idea that his profession is narrow and that there are definitely defined limits beyond which he should not step, must be dispelled from the mind of the engineer. To the young man who is trying to make up his mind regarding the selection of a life work, who would like to take up engineering

but hesitates, let us say go ahead, you cannot make a mistake in this choice; to the graduate of our technical schools, who looks out upon the world and is discouraged because there seems to be no room for him, let us suggest that he look beyond the places where he must actually make use of the theoretical formulae he has mastered; and to the man engaged in a technical pursuit, who has long since gotten into a rut which is becoming deeper and deeper, the engineer who is fussing and fuming and worrying his life away because he is on the wrong road, let us advise that he risk the shock of pulling himself out of what, for him, is not the proper environment and of turning into any of the roads which point to success in the business world. If he knows how to be a man among men, let him take up sales engineering.

Salesmen You Ought to Know

This respectable middle-aged gentleman is not Theodore Roosevelt, but in his Rough Rider make-up he could easily impersonate the Colonel. He is a good fighter all right and for 20 years, as Eastern manager, fought for business for the Platt Iron Works. This veteran is George W. Neff, Hudson Terminal, New York City, New York. He recently changed to the John H. McGowan Co., makers of pumping machinery. He also handles all lines of power plant equipment. He covers

GEO. W. NEFF.

the New York and New Jersey territory and looks after the export trade. He is single only during the vacation season when he hies himself to Plainfield, N. J., to get away from subways and to find a place in the sun. The rest of the year he is married. He has one wife and one child. His hobby is vegetable gardening. Nothing foolish about this old boy—he already has a cellar full of potatoes and such like and can afford to let the heathen rage. His health is fine and his disposition has improved greatly since he gave away his gasoline buggy.

Smiling pleasantly, Mr. F. William Stocker appears on the reader's left. He is shown seated in his Stutz car and is "just after" scaring his passenger half doty with a burst of speed. He was after a big order and got it. F. William, as you doubtless know, is president of F. William Stocker, Inc., engineers, Hoboken, N. J. They deal in concrete specialties, metal forms, motor trucks, water-proofing, damp-proofing, curb-bars, paving joint and road mesh. Among the lines he represents are: United States Motor Trucks, Pittsburgh Paving Joint and Hotchkiss Metal Forms. He covers New York and New Jersey. Mr. Stocker, his cheerful appearance to the

F. WM. STOCKER.

contrary notwithstanding, is marriied, and that isn't all—he has three kiddies. He is a hunting sport and spends some time in the Adirondacks each summer, hunting game, scenery and action. He is one salesman who never Sundays at home. He is fond of the Waldorf Astoria and of the screen stars. He admits a preferance for Theda Bara.

This mysterious picture was snapped in Guatemala. It shows a monument of unknown antiquity and R. C. Tillinghast, also a holdover from former times. Mr. Tillinghast admits that he lives at 256 Broadway, New York. He has been representing Watson Tractor Trucks, Tractors, trailers and dump wagons ever since Joe Walker first built state roads. He covers Eastern New York, Northern New Jersey and New England. Each year, after Thanksgiving Day, he

R. C. TILLINGHAST.

takes his wife to Central America or the West Indies. But more about the monument—all savants save Mr. Tillinghast have failed to decipher the inscription. He quickly saw that it was an unsolicited testimonial which had never reached him. The portrait of the contractor who furnished the testimonial appears on what he used as a letter head. It may be this man was Superintendent of Public Works. However that may be, he was a sport and was there with the pitching chisel.

DIGEST OF THE ESSENTIAL NEWS

Municipal Engineering Takes Larger Quarters

In line with a general policy of expansion, effective in all departments, MUNICIPAL ENGINEERING has removed from 608 South Dearborn street to the Rand-McNally building, 538 South Clark street, Chicago, where larger quarters have been leased. Friends of the paper are invited to make this office their headquarters when in Chicago.

Lakes to Gulf Waterway Project

Perhaps no engineering project in recent years, with the exception of the Panama canal, has so fired the imagination of the engineer as the Lakes to the Gulf waterway project, involving the construction of a ship canal across Illinois to connect Lake Michigan and the Mississippi river. All the plans discussed in connection with this project contemplate, of course, the utilization of existing water ways along the route of the canal.

Former Governor Dunne, of Illinois, was a strong advocate of this project, and it was something of an issue in the latest gubernatorial contest in Illinois. Many felt that Governor Lowden would not be favorable to the waterway project, and this caused many engineers to support the candidacy of Mr. Dunne.

Governor Lowden is making a brilliant, constructive record, and it should, therefore, occasion no surprise to learn that his administration is favorable to the construction of the ship canal. Leslie D. Puterbaugh, director of the Illinois State Department of Public Works and Buildings, recently gave out an interview to Chicago newspapers announcing this fact.

The editor has just had a letter from William L. Sackett, superintendent of the Division of Waterways, indicating that the department will have a definite deep-waterways plan formulated in a short time. The Lowden administration has shown such marked ability to get results that engineers, contractors and others interested may feel confident that this project will get beyond the conversational stage before long.

Present Status of the Imhoff Tank Patents in This Country

The following statement has been issued by the Pacific Flush Tank Company, of Chicago, relative to the present status of the Imhoff sewage settling tank patents in this country and the payment of royalties for the use of these tanks:

Since the introduction in 1911 of the Imhoff tank for sewage treatment in the United States, we have been the commercial representatives for Dr. Karl Imhoff in the matter of collecting royalties under his patents and in the distribution of literature, etc., relative to such patents.

Our relations with Dr. Imhoff since their inception have been very friendly, but the present war has placed us in a somewhat embarrassing position, which, it seems to us, calls for an explanation to those interested.

The war with Germany prevents us from remitting further royalties to, or in any way communicating with Dr. Imhoff, who has become an alien enemy. This being the case, we have asked our Chicago attorneys, Messrs. Mayer, Meyer, Austrian & Platt, for an opinion as to the proper course to pursue in handling the matter until Dr. Imhoff, or his heirs and assigns, can be legally communicated with.

While the law forbids communication with an alien enemy during the war, it probably will not abrogate the ultimate rights of such alien enemy, and although we cannot at present transmit royalty fees to Dr. Imhoff, his right after the war to collect such royalties will in all probability be the same as if the war had not existed.

In order to protect those who are using or may in the future use the Imhoff tank for sewage treatment, we have decided to deposit with the First Trust and Savings Bank of Chicago in a special trust fund all moneys received by us for account of Dr. Imhoff after date. This fund will remain in trust until commercial relations with Germany may be legally resumed. For funds so paid we shall furnish a receipt and a certificate from the above named bank that said funds have been deposited with it in trust. In cases where no license has as yet been furnished by Dr. Imhoff, these funds received by us since the President's proclamation will be held in trust by the bank until such a license has been received from him, his heirs or assigns, or until otherwise disposed of legally.

We submit the foregoing explanation of our position to those who contemplate building or who have let contracts for Imhoff tanks, or who have already completed the construction but have not paid a license fee. The following table shows the royalty fees as heretofore prescribed by Dr. Imhoff, said fees being based upon the population ultimately to be served:

ROYALTY FEES ON IMHOFF TANKS

Pop.	Fee min.	Pop.	Fee	Pop.	Fee
100	$ 10	2,500	$155	15,000	$ 590
200	20	3,000	180	20,000	750
300	30	3,500	200	25,000	850
400	40	4,000	220	30,000	1,000
500	50	4,500	235	40,000	1,300
600	58	5,000	255	50,000	1,500
750	65	6,000	290	75,000	2,100
1,000	80	7,000	325	100,000	2,550
1,500	105	8,000	360	200,000	4,300
2,000	130	10,000	430	350,000	6,800

Our plan, we believe, will enable contractors to complete their contracts, pay royalties, and secure their release, and at the same time protect all cities or others desirous of using the Imhoff tank. In this connection we wish it distinctly understood that in suggesting this plan we assume no personal liability or responsibility other than herein disclosed.

The patents held by Dr. Imhoff and the date of their issue are as follows: June 5, 1909—No. 924,666; Dec. 20, 1910—No. 978,889; Feb. 18, 1913—No. 1,053,396; March 25, 1913—No. 1,056,548; March 25, 1913—No. 1,057,154.

Good Roads Notes

The county commissioners of Tillman county, Oklahoma, have appointed the county engineer as county manager, putting the road and bridge work of the county in his charge, acting under the general direction of the county commissioners in matters of policy.

In Nova Scotia, where it has been quite difficult to obtain labor of late, it has been found that this difficulty in the way of highway construction can be overcome in a measure by a wider use of road machinery, particularly graders. The pro-

vincial road commissioner, Hiram Donkin, is making a specialty of instructing men in the use of such equipment, in order that the full benefit of machinery may be obtained in every part of the province. The conditions on many of the Nova Scotia roads are such that roadbuilders accustomed to working graders in light to medium soil only, would be afraid to use them in the heavy soil of many parts of the province. It has been found, however, that by first using a road plow to loosen roots of bushes, boulders and hardpan, the road grader can finish the work easily and the total cost will be less than that of grading and ditching by hand and light tools, at the present wages for labor.

Progress in Sewage Disposal in Philadelphia

The officials of the city of Philadelphia have been giving very exhaustive study to the problem of sewage disposal since 1907. It will be remembered by our readers that in 1915 the Bureau of Surveys issued a report recommending a comprehensive plan for the collection, treatment and disposal of the sewage of the entire city.

In the summer of 1915 councils appropriated $500,000 to begin this project, and in the summer of 1916, in the $115,000,000 loan bill, appropriated $3,200,000 toward sewage disposal.

In accordance with the recommendations in the report, this money is being spent in the northeast division of the city, where the interception and treatment of the sewage will accomplish the greatest good by protecting from sewage pollution the source of the water supply of the city and also in restoring to a clean condition the grossly polluted Frankford Creek.

About 2¾ miles of the large Frankford Creek intercepting sewer and a grit chamber are under construction; land has been acquired for the sites of the northeast and southwest sewage treatment works, and a contract for $1,025,000 has been awarded for the construction of 32 horizontal-flow rectangular reinforced concrete two-story sedimentation tanks, with their appurtenant sludge drying beds—the first increment of the northeast sewage treatment works.

LIGHTS AND SHADES

Smokes For You

Of course you smoke—well then, listen. Good stories are wanted for this department—stories of the construction camp, of the drafting room, of the engineering classroom, and of everything else in which engineers and contractors figure. You know the kind—polite but not necessarily lady-like accounts of funny things seen, heard or experienced in the day's work. Wait a minute, we're coming to that. You have all got good stories wrapped up in your systems—here is a chance to elaborate them. Now here it is: For the best story received for publication before Christmas we will give a five-dollar box of cigars or the same value in eating tobacco, at the winner's option. The winner will be picked in a staff conference. In case everybody disagrees with the editor it is expressly understood the editor's choice wins. Moral: Be good to the editor.

Gumshoe Bill Doesn't Like Our George

General Goethals and his Panama canal are regarded without enthusiasm, it seems, by Senator Stone of Missouri. Said the senator: "I have never been, I am frank to say, a very enthusiastic admirer of General Goethals. I barely know him. I do not recall ever meeting him more than once, but I am somewhat familiar with his career, and for one I venture to say, which I would not have done except in the immediate circumstances, that he is rather a pampered hero, whose reputation, such as it is, has been built largely upon the genius of other men. I go further and say that with the combined genius of them all, with the genius and intelligence of them all, the Panama canal lacks a vast deal of being a great engineering success. I regard it rather as a failure. I express that as my opinion." Some opinion.

Assertion Versus Argument

Don't give 'em too much to think and talk about—if you do they will talk themselves out and kill the project. In making reports where the comparative merits of several projects are discussed engineers should remember this. Soft pedal all the projects except the one recommended. Don't argue too much—make assertions instead. Watch T. R.—he knows how! Ever know him to state two sides of a case? He begins with a strong assertion and supports it with a series of assertions, each stronger than the one before. Let the people rule, yes, but make it impossible for them to blunder. Leave them just one choice and make sure that is the right one. Recognize the impotence of the wind blown away in popular discussions of engineering projects. This wind, by the way, blows away many fees, first and last.

Consider the Catenary

Exhumed from a mathematical treatise: "And so, no force, however great, can stretch a cord, however fine, into a horizontal line which shall be absolutely straight." Do you get the rhythm?

Architects, Too, Have Their Troubles

A newspaper writer quotes a Chicago architect as saying that when a window sticks in a new house the owner calls up his architect, about 2 a. m., to say that the house is a great disappointment and that he is sorry he had it built.

Definition

Said a prominent English jurist: "There are three kinds of liars, namely, liars, liars with a condemnatory adjective, and my brother William, who is an appraisal engineer."

Listen to Jim Hill's Son

Scoring the business slacker, Louis W. Hill of the Great Northern Railroad said: "The manufacturer or merchandiser who lays down at this moment—the commercial crepe hanger—is quite as definitely a non-patriot as the man who refuses to fight."

Origin of "Graft"

Those who claim to know say that the word graft was first used in the United States in connection with a small canal construction job, in New York, about 250 years ago. "Graft" was, and for all we know still is, the Dutch word for canal. Three laborers did the digging and a paid committee of five men watched the work to see that the laborers earned their wages. Now you know.

Study Engineering, Says Chicago Tribune

This editorial recently appeared in the Chicago Tribune, "The World's Greatest Newspaper:"

"Hardly more than half the usual number of young Americans are now enrolled as students of engineering, whereas there should be twice the usual number, for the larger part of the civilized world will have to be reconstructed after the war. Industrial plants, bridges, railroads are going to rack and ruin even when they escape destruction. War overworks them and prevents repair. If the war lasts two years even America will have felt the strain. The demand for engineers will greatly exceed the supply.

"We shall be unable to import them. When war broke out practically all the engineering schools abroad shut down, and engineers in Europe have since been slaughtered wholesale. Instead of our relying on Europe, Europe hopes to rely on us. As things look at present, it is a forlorn hope.

"The Society for the Promotion of Engineering Education recently went over the whole question at its meeting in Washington. Several remedies are suggested. One would discourage enlistment among students of engineering. Another would put those who are drafted in the engineering corps. Still another would provide government aid for young men willing to enter a technical school. The more practical suggestion and the one easiest to apply is the call for proselyting. Tell every boy of your acquaintance that engineering will be the best paid profession for at least ten years after the war. That is the truth. Make him see it. Any lad with the requisite gifts will find the technical school an open door to success and prosperity and incalculable usefulness."

"Engineering will be the best paid profession for at least ten years after the war." Perhaps. Before engineers become well paid they must get over bowing and scraping and saying, "Thank you, sir!" when they are handed a one dollar fee for a five dollar service.

A Practical Suggestion

Clancy, the paving contractor, had dug deep and often for the new church. At length it was built and furnished from basement to belfry except for the church bell itself. A meeting of the angels was called to raise funds for the bell. Clancy's turn came. He said: "We've a fine church with fine pews and a fine pulpit. We have a fine steam heatin' plant, too, so I move you that we can this bell idea and put a whistle on the church!"

Stephenson's Early Difficulties

In his boyhood George Stephenson herded cattle and drove a ginhorse in a coal mine for six pence a day. Not until his eighteenth birthday was he able to read! For fifteen years he worked unceasingly on what many people called a dream, but success came finally on Sept. 27, 1825, when he opened the first railway over which freight and passengers were hauled by a locomotive. He had great native ability, yes, but he also had great perseverance.

FIRE ENGINEERING

The "Two-Platoon System" in Chicago

Marked difference of opinion still exists among Chicago authorities as to the success of the two-platoon system in actual practice. As a means of checking up the men available under the two systems, a careful count was made of the men at the first fire after the passing of the two-platoon ordinance, this figure being compared with an authoritative estimate of the men who would have been on the job under former conditions.

Claims made by Geo. B. Horgan, president of the Fireman's Association of Chicago, show that sixty-six men were present at the fire, while under the old method there would have been only sixty-five.

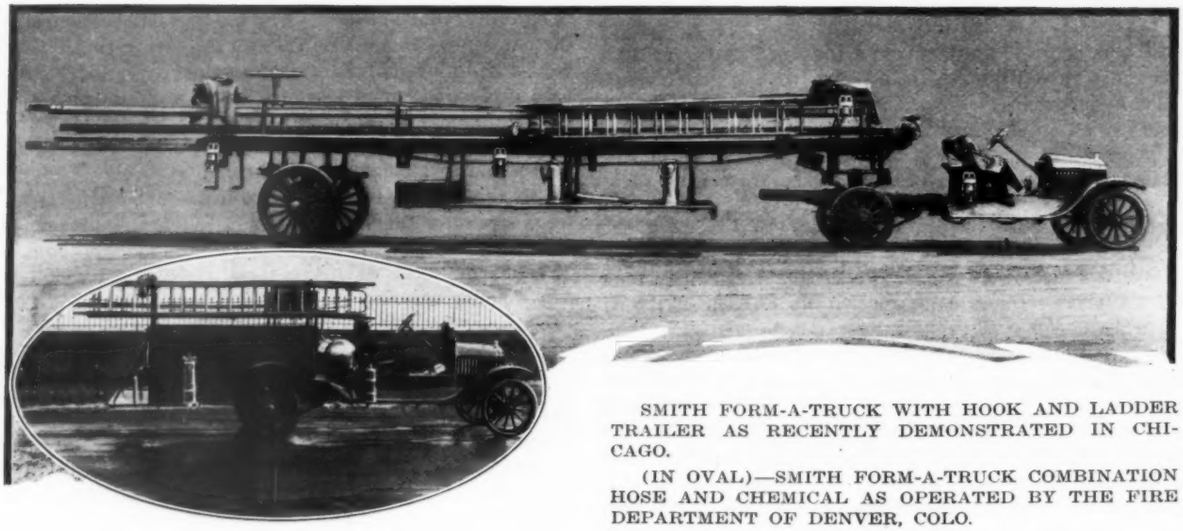
According to the statements of the officers of various companies which responded to this first call, the number of men at the fire was sixty-two instead of sixty-five, and under the old arrangement would have been seventy-three instead of sixty-five, as stated by the supporters of the system formerly in vogue.

In presenting both sides of the question, a table was made up showing the figures as given by the Fireman's Association and the company officers. The last column gives the additional number of officers that would (under the old system) have been available had the fire occurred at 9 p. m. or later, after these men had returned from theater detail. The table follows:

	New system		Old system		9 p. m.
Co.	Ass'n	Officers	Ass'n	Officers	Officers
20	6	5	5	6	7
30	6	6	6	6	8
35	6	6	6	6	8
111	5	5	5	5	7
26	6	7	6	7	8
33	6	5	6	7	8
43	6	5	6	7	8
57	6	5	6	6	7
19	7	6	7	7	8
28	6	6	6	8	9
Sq.	6	6	6	8	8
Total	66	62	65	73	86

Lafayette Buys Fire Truck

The South Bend Motor Car Works recently delivered to West Lafayette, Ind., one of their type PCH-97-6, 500-gallon Hoosier pumps. Before acceptance this pump was put thru two underwriters, both of which it passed with flying colors. The first test for 1½ hours full capacity delivering 550 gallons per minute at 120 lbs. pump pressure through two 50-ft. lines siamesed into one 1⅜-inch nozzle. In the second



SMITH FORM-A-TRUCK WITH HOOK AND LADDER TRAILER AS RECENTLY DEMONSTRATED IN CHICAGO.

(IN OVAL)—SMITH FORM-A-TRUCK COMBINATION HOSE AND CHEMICAL AS OPERATED BY THE FIRE DEPARTMENT OF DENVER, COLO.

test, (1 hour) 340 gallons per minute, were delivered through one 100-ft. line with 1-in. nozzle, at 200 lbs. pump pressure.

This same car was driven to St. Joseph, Mich., to the Michigan State Fireman's Convention and several demonstrations were given for the benefit of the Michigan chiefs.

Before this car was accepted and before going through the underwriters' test at West Lafayette, an alarm was given from Kirkpatrick, Ind., a distance of 27 miles and this car was sent over by the delivery engineer in forty-five minutes. It was "on the job" for four hours, working to such good advantage that it prevented the destruction of several buildings and grain elevator.

Other recent deliveries made by the South Bend Company are one type CH-60 and one type CH-40 combination wagons to the City of New York and two type CH-40 combination wagons to Weehawken, N. J. Among the recent contracts are six type H-60 hose wagons and one type 40 tool car to Cleveland, Ohio, one type CH-40 to Coldwater, Mich., one type PCH-140-6 to Kendallville, Ind., two type PCH-95-4 350 Gallon Hoosier Pumps to Muncie, Ind., one type PCH-97-6 500-gallon Hoosier Pump to Oxford, Pa., one type CH-60 to Newburgh, N. Y., three type S-120-6 Squad cars to Newark, N. J., and one type CH-95-4 Combination Car to Gary, Ind.

A New "Ford" Firefighter

A new piece of motor fire apparatus which is built on the standard Ford chassis has recently been placed on the market by its manufacturers.

This machine, which is a product of the Buckeye Manufacturing Co., combines in one piece of apparatus the advantages of a gasoline pumping fire engine and a first-class chemical equipment; carries a small ladder equipment and is arranged to draw the hose reel or hook and ladder truck behind it as a trailer on the smaller model. The machine is also built with a hose body. This makes a complete triple combination outfit.

As a water-throwing engine its capacity is 200 to 250 gallons per minute, and it will throw three streams of water 80 to 100 feet high in still air and 130 to 140 feet horizontally, pumping from open water, such as a cistern or pond. Where the town has a water works system and the pressure is too weak to do good service on a long line of hose, it will attach to any hydrant and add 80 to 100 pounds pressure to the stream, giving a strong and efficient stream where the water pressure alone is too low to be effective, thus enabling a town to get good fire pressure from an inexpensive low pressure water system.

As a chemical engine high efficiency is claimed for it. It gets its pressure from the motor and pump, and so has no pressure in the tank at all, hence the tank can be opened at any time and water and chemical added. Thus the supply can be renewed and kept up continually without ever stopping the stream, and the pressure is always very strong and unvarying. As there is a constant strong stream from the bypass back into the tank, the chemical is always thoroly agitated and mixed and at its maximum efficiency.

It has a speed of 25 to 30 miles per hour, and gets to the fire so quickly that probably nine out of every ten fires could be extinguished with the constant chemical with no water damage whatever to the structure.

If the water is inaccessible to the fire from the water mains it will take water from any stream, well or cistern and throw six to eight barrels per minute 100 feet high, or it will boost a weak, ineffective hydrant stream 100 pounds or more and make it strong, penetrating and effective.

The use of corrosive acid is entirely avoided in this chemical engine. This acid, used in other types of chemical, has proven dangerous for amateurs to handle under excitement and is destructive to the equipment itself; but the use of this acid is entirely eliminated by the new machine. There has been some effort made in the past to mount chemical tanks on the Ford chassis, but when sufficient chemical capacity is obtained the weight of the apparatus makes an overload for the car, while with the Howe-Ford apparatus 200 to 250 gallons capacity, such as is not possible with any other system, is obtained without overloading.

While the two machines thus described; namely, the model C, which carries the discharge hose in a trailer or hose reel, and the model H, which is a triple combination outfit and incorporates in the machine itself the hose body, proves so valuable to the small town it is relatively as valuable to larger towns for this reason. It is often the case in towns where they buy apparatus, of say from 700 to 1,200 gallons per minute capacity, that in attaching to the water mains the apparatus would have the capacity of pumping the water, but the mains do not have the capacity for delivering it thru a single pipe line. In this case four or five of these smaller machines can be purchased at about the same initial cost as the larger machine, and the same capacity is obtained. The smaller machine can be attached to separate hydrants, and it will be seen that the hydrants will not be "pumped dry" by one of these engines, and that more than 1,000 gallons can be supplied by all of these machines without danger of running out of water because it could not be supplied by one pipe line.

With these smaller units the chance of a breakdown is practically eliminated, as a single unit could be out of com-

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mission without any very serious results, while if the single machine, from any cause, should fail to operate, the fire might cause a total loss of the property before it was possible to get the single unit in operation.

The Howe-Ford carries complete equipment, including 150 feet of chemical hose, lanterns, hand fire extinguisher, fire axe, crowbar, spanners, wrenches, and such other accessories as are necessary.

PERSONAL ITEMS

Frank Koester, consulting engineer and city planning expert, Hudson Terminal building, New York City, has been retained by the City Planning Commission of Allentown, Pa., to prepare street plans for the site of an 8-mile railroad to be built by the Lehigh & New England Railroad Company, of Bethlehem, to avoid dangerous and costly grade crossings. This railroad, to be used exclusively for industrial developments, lies within the jurisdiction of the City Planning Commission of Allentown, for which Mr. Koester a year ago prepared a comprehensive city planning report.

O. Lourgaard has been appointed city engineer of Portland, Ore., to succeed Philip H. Dater, who resigned after holding the office for years.

Andrew T. Hansen, formerly chief deputy city engineer of Los Angeles, Cal., has been appointed city engineer, to succeed Homer Hamlin, who had held the position since August, 1906. Mr. Hamlin was removed from office by the Board of Public Works, following disagreements relative to reports on paving work, in which his recommendations were contrary to the views held by the board. In connection with this action the board paid a high tribute to Mr. Hamlin for the valuable services he has rendered the city in past years.

Philip Guise has been appointed county engineer of Sussex county, New Jersey, to succeed Harvey Snook. He will also serve as city engineer of Newton, N. J.

W. H. Ellis has been appointed commissioner of public works of Butte, Mont., to succeed Edward G. Kane, who resigned. Mr. Ellis was formerly assistant city engineer of Anaconda, Mont.

C. C. Cottrell, formerly on the engineering staff of the California Highway Commission, has been appointed assistant highway engineer of the State of Nevada.

The Barney-Hocke-Ahlers Construction Corporation, with offices at 110 West Fortieth street, New York City, has been formed to engage in water front and concrete construction. The members of the firm are all experienced engineers and contractors.

C. E. Henderson, formerly city engineer of St. Augustine, Fla., has resigned to become county engineer of St. Johns county, with headquarters at St. Augustine.

John F. Hayford, dean of engineering at Northwestern University, Evanston, Ill., is in Washington, serving as a member of the National Advisory Committee on Aeronautics.

James M. Barker, professor of civil engineering in the Massachusetts Institute of Technology, Boston, Mass., has been appointed consulting bridge engineer for the Massachusetts Public Service Commission.

William F. Moore, formerly city engineer of Grand Rapids, Mich., has been appointed state highway engineer for Indiana. He was city engineer of Grand Rapids for over two years, going there from South Bend, Ind., where he had been city engineer for six years. He was at one time city engineer of Mishawaka, Ind., and years ago was in the contracting business.

M. P. Paret has opened a consulting engineering office at Lake Charles, La. He was formerly on the engineering staff of the Interstate Commerce Commission.

William Smith has been appointed city engineer of Jackson, Ky., to succeed Henry Dennen, who resigned the position because of bad health.

George Wells, with headquarters at Pikesville, Ky., has been appointed county engineer of highways for Pike county.

Francis F. Longley, for years a member of the firm of Hazen & Whipple, consulting engineers, New York City, has been given a major's commission and sent to France, where he will take charge of all water supply engineering required by the American army in France. In going back to military service he is going home, for he is a West Point graduate of the class of 1902. He has had a varied experience in water engineering.

J. H. Prior has resigned his position as chief engineer of the Illinois Public Utilities Commission to open an office as consulting engineer in Chicago.

Le Roy K. Sherman, well known in the Middle West for his work on the engineering staffs of public commissions, has opened a consulting engineer's office at 137 South La Salle street, Chicago. He will specialize in water engineering, land drainage, sewage treatment and public utility valuation. He was formerly engineer member of the Illinois River and Lakes Commission. Prior to that time he was assistant chief engineer of the sanitary district of Chicago, and built the widely-known hydro-electric plant of the district at Lockport, Ill.

Capt. Paul Hansen, of the Engineer Officers' Reserve Corps, formerly chief engineer of the Ohio, Kentucky and Illinois State Boards of Health, and at one time engineer of the Illinois State Water Survey, has been ordered to report for active duty with General Pershing's army in France. Every good wish accompanies this kindly, talented, public-spirited man.

COMING CONVENTIONS

LEAGUE OF AMERICAN MUNICIPALITIES—Annual convention at Gary, Ind., Sept. 5-8. Sec'y, Robert E. Lee, City Hall, Baltimore, Md.

NEW ENGLAND WATER WORKS ASSOCIATION—Annual convention at Hartford, Conn., Sept. 11-14. Sec'y, Willard Kent, 715 Tremont Temple, Boston, Mass.

LEAGUE OF IOWA MUNICIPALITIES—Annual convention at Iowa City, Sept. 18-20.

LEAGUE OF CALIFORNIA MUNICIPALITIES—Annual convention at Santa Rosa, Cal., Sept. 24-29. Sec'y, Wm. J. Locke, Pacific Bldg., San Francisco.

NATIONAL ASSOCIATION OF PURCHASING AGENTS—Annual congress at Pittsburgh, Pa., Oct. 9-11. Permanent headquarters, 600 Westinghouse Bldg., Pittsburgh.

LEAGUE OF MINNESOTA MUNICIPALITIES—Annual convention at St. Cloud, Oct. 17-18. Sec'y, Richard R. Price, Univ. of Minnesota, Minneapolis.

CITY MANAGERS' ASSOCIATION—Annual meeting at Detroit, Nov. 19-24. Sec'y, W. L. Miller, City Manager, St. Augustine, Fla.

FIRST CHICAGO CEMENT MACHINERY AND BUILDING MATERIAL SHOW—Supersedes annual Chicago Cement Show. To be held under auspices of the National Exhibition Co., 123 W. Madison St., at the Coliseum, Feb. 6-13, 1918.